The Epitoniidae (Gastropoda: Ptenoglossa) from the lower Alum Bluff Group (lower to middle Miocene) of Florida, with descriptions of nine new species

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ABSTRACT

A comprehensive study of the family Epitoniidae that exists in the lower to middle Miocene portion of the Alum Bluff Group of Florida (USA) was conducted. A total of 14 species was examined. Of these, 12 are considered valid members of the family Epitoniidae. They include three previously described species, *Amaea gardnerae*, *Cirsotrema cirritum*, and *Epitonium virginiae*, plus nine new species. Seven of the new species were collected from the Chipola Formation and two from the Shoal River Formation. One new species is assigned to the genus *Cirsotrema*, two are assigned to the genus *Opalia*, and six are assigned to the genus *Epitonium*.

Cirsotrema previously reported from the Chipola Formation as *Cirsotrema dalli*, a Pleistocene to Recent species, has been described as a new species. *Epitonium alaquaense* reported from the upper Miocene Choctawhatchee Formation (upper Alum Bluff Group) and questionably placed in the Shoal River Formation fauna by Gardner (1947) is no longer recognized as a Shoal River Formation species and *Gegania acutissima* has been placed with the *Architectonica*-like members of the family Mathildidae.

Additional Keywords. Miocene, Chipola Formation, Shoal River Formation, *Cirsotrema*, *Opalia*, *Epitonium*, Chipola River, Tenmile Creek, Farley Creek

INTRODUCTION

The family Epitoniidae has an extensive history with representatives dating back to the early Mesozoic. According to Clench and Turner (1950), the group appears to have reached its peak of diversity during the Eocene and Miocene epochs. In Florida (USA), members of the family are well represented in early Miocene deposits and, to a lesser extent, in middle Miocene deposits of the Alum Bluff Group.

The Alum Bluff Group consists of five named stratigraphic units (Figure 1). From oldest to youngest these units are the Chipola Formation, Oak Grove Sand, Shoal River, Choctawhatchee, and Jackson Bluff formations (Huddlestun, 1984). All of the Alum Bluff strata occur in outcrops in the western portion of the Florida panhandle (Figure 2). The lower Miocene Chipola Formation was deposited approximately 18 mya (Jones et al., 1993) and outcrops along Tenmile, Farley, and Fourmile creeks, and the Chipola, Yellow, Choctawhatchee, and Apalachicola rivers. To date, most Chipola Formation specimens have been collected from Tenmile, Farley, and Fourmile creeks, and the Chipola River. Collections of fossil specimens from the Oak Grove Sand along the Yellow River and the Chipola Formation along the Apalachicola River are limited, given that these locations typically can only be accessed during very low water levels. According to Vokes (1989), Tenmile Creek, Farley Creek, and Chipola River complex alone encompasses over 7.5 miles (~12 km) of Chipola Formation exposures. The middle Miocene Shoal River Formation was deposited approximately 12 mya (Jones et al., 1993). All known Shoal River Formation outcrops are west of the Chipola Formation exposures with most of the collecting areas situated along the Shoal River in Walton County. Overviews of the geology, stratigraphy, and paleontology of the Chipola and Shoal River formations can be found, respectively, in Vokes (1989) and Portell et al. (2006).

Gardner (1947), as part of her monographic treatment of the molluscan fauna of the Alum Bluff Group, discussed three species belonging to the family Epitoniidae. These species were *Epitonium* (*Spiniscala*) *virginiae* (Maury, 1910), *Epitonium* (*Clathrus*) *alaquaense* (Mansfield, 1935), and *Gegania acutissima* (Dall, 1892). However, only two of these taxa are herein considered to belong to the family Epitoniidae. *Epitonium virginiae* was collected from a Chipola Formation site along the east bank of the Apalachicola River. It was described by Maury (1910) from a single, extremely small (3.7 mm maximum height × 1.5 mm maximum width) specimen that was part of the Cornell University Collection (now deposited at the Paleontological Research Institution). *Epitonium alaquaense*, recorded by Mansfield (1935)

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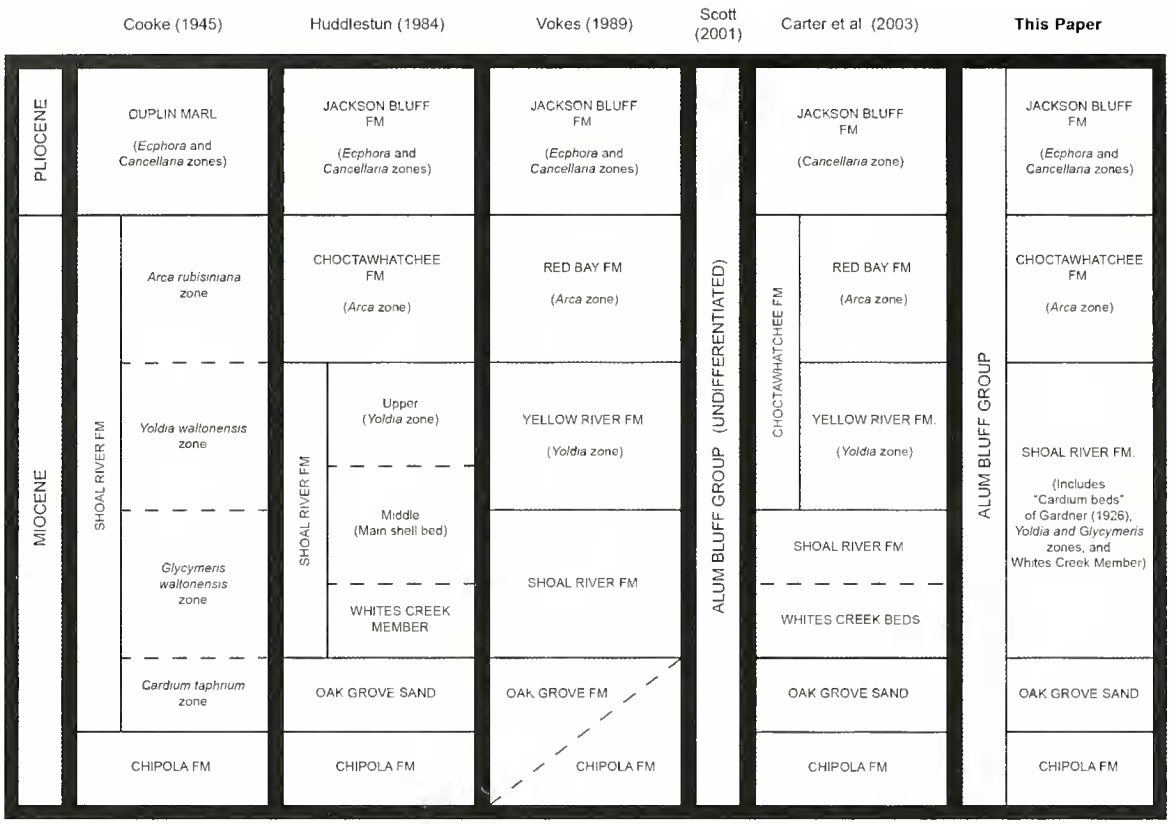


Figure 1. Alum Bluff Group stratigraphic nomenclatural history and correlation (in part). Modified from Portell et al. (2006).

from the *Arca* zone of the Choctawhatchee Formation, is late Miocene (Huddlestun, 1984). When Gardner (1947) collected a shell fragment similar to Mansfield's shell at a Shoal River site she included it as part of the lower Alum Bluff Group as defined by Cooke (1945). The collective evidence now suggests that *E. alaquaense* should not be listed as part of the fauna of the lower Alum Bluff Group (see Figure 1). The reasons for this are twofold. First, an extensive examination of the Chipola and Shoal River formation fossils in the Florida Museum of Natural History (including Tulane University and Florida Geological Survey collections), Paleontological Research Institution, Smithsonian's National Museum of Natural History, American Museum of Natural History, The Academy of Natural Sciences, Alabama Geological Survey, and private collections during this study did not uncover a single specimen that could be referred to as *E. alaquaense*. Second, Gardner (1947: 577) stated that she collected her shell fragment from "a horizon slightly higher than the typical Shoal River formation." Based upon this remark and that no additional specimens similar to *E. alaquaense* were ever found in the abovementioned collections, it seems fair to assume that Gardner's specimen belonged to strata younger than the Shoal River Formation; most probably to the upper Miocene Choctawhatchee Formation.

Dall (1892) described *Tuba acutissima* and placed it in the family Mathildidae. Gardner (1947) replaced the genus *Tuba* with *Gegania* and tentatively assigned it to the family Epitoniidae because she felt that its morphological characteristics more closely coincided with the suborder Ptenoglossa. Gardner's generic assignment of *Gegania* was based upon the shell similarity to *Gegania pinquis* Jeffreys, 1884, a species collected during the Porcupine Expedition off Cape Mondego, Portugal. However, the genus *Gegania* has since been assigned to *Architectonica*-like members of the family Mathildidae (Vaught, 1989).

In addition to the three species of Epitoniidae listed for the Alum Bluff Group, Gardner (1947: 575) reported shell fragments belonging to "at least a dozen" species. Gardner stated that most of the specimens were so imperfectly preserved that only subgeneric determinations could be made. Four of the unidentified epitoniids came from the Aldrich Collection (housed at Johns Hopkins University) and the remaining species were from Gardner's collection. Eleven of the fragments were obtained from Shoal River Formation localities and two were collected from Chipola Formation sites. Gardner placed eleven of the fragments in the genus *Epitonium*, one in the genus *Scalina*, and one in the genus *Gegania*. Six were placed in the subgenus *Hyaloscala*, two in *Spiniscala*, three in *Cinctiscala*, and one in *Nodiscala*.

It is apparent from Gardner's (1947) discussion on the Epitoniidae of the Alum Bluff Group that future work remained to be done on the family. Since her publication, three additional species of Epitoniidae have been reported from the Chipola Formation. These are *Cir-*

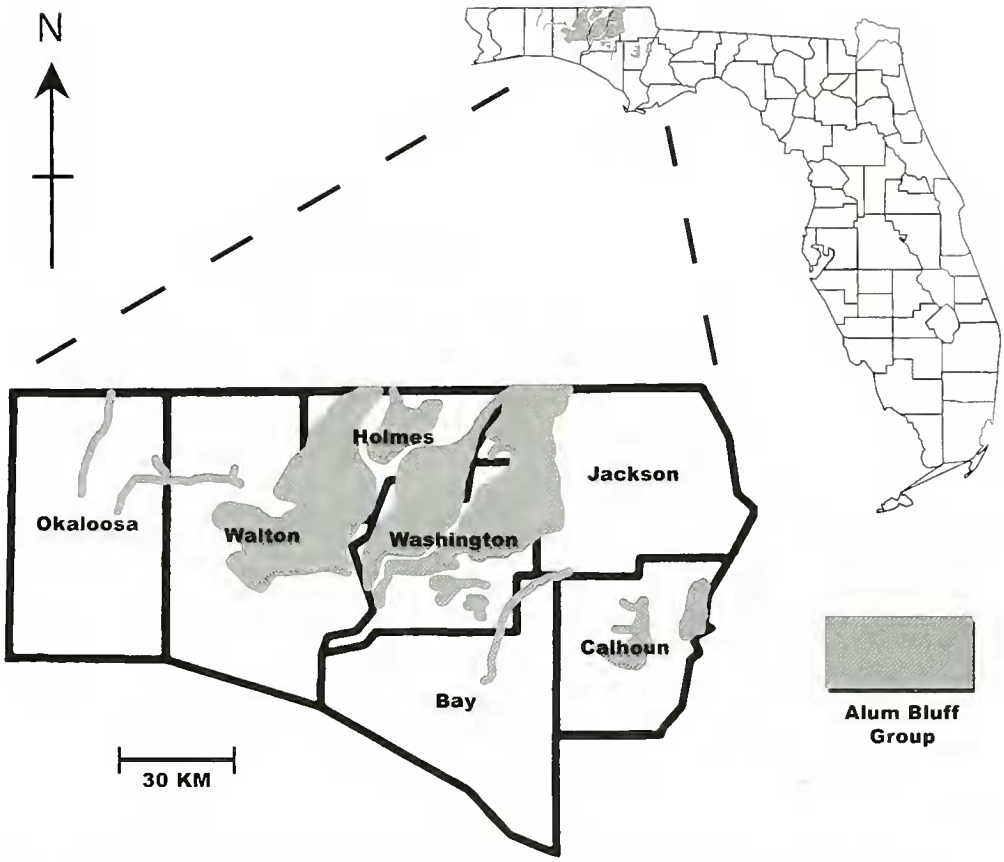


Figure 2. Map of Florida showing counties with Alum Bluff Group sediments found at or near the surface.

sotrema dalli Rehder, 1945; *Scalina gardnerae* (Olsson, 1967); and *Cirsotrema cirritum* Duerr, 2004. *Cirsotrema dalli* is an extant species reported to have undergone little morphological change since the early Miocene (Olsson, 1967). *Scalina gardnerae* was described by Olsson (1967) from a single large specimen collected from McClellan's Farm in Calhoun County, Florida. It is a fairly common species, and since its discovery, it has been found at numerous Chipola Formation sites by the authors and other investigators. *Cirsotrema cirritum* is a much less common species collected at a few sites along Tenmile and Farley creeks and the Chipola River (Duerr, 2004).

Scattered among the material in museums and private collections are a large number of epitoniids from the Chipola and Shoal River formations of Florida that have been amassed over the last fifty years. Since many of the recently collected specimens are in excellent shape, we have undertaken the task of identifying and describing the new species and providing better descriptions and updated taxonomic placements of existing ones. As will be evidenced in this paper, many of these epitoniids have shell structures that are similar to those of extant and fossil species from Florida, the Caribbean, western Europe, and the eastern Pacific.

According to Clench and Turner (1951), DuShane (1979), Kilburn (1985), Nakayama (2003), Robertson (1983a; 1983b; 1993), Weil et al. (1999), and others, current classification of the Epitoniidae is based upon shell characteristics. For this study, morphological features such as shell size (height and width), number and shape of the nuclear whorls, number and shape of teleoconch whorls, number and placement of the costae on the body whorl, presence or absence of varices, type of sculpturing on the body whorls, shape of the aperture, shape and thickness of the outer lip, depth of the suture, presence of punctae, and the spire angle were used to help differentiate species. Spire angles were measured from photographs. A vertical line was drawn through the axis of the shell and a protractor was used to determine the angle between the margins of the body whorls on both sides of the shell.

Additionally, in order to ascertain whether or not the Chipola Formation species of *Cirsotrema* is the same as the Recent *Cirsotrema dalli*, we closely examined the varices on both forms. As noted by Weil et al. (1999) and others, the presence or absence of varices can be a key diagnostic feature for some species of *Epitonium*. We believe that the structural configuration and the number of varices that appear within a specific generic group, such as in certain *Epitonium*, will change over geologic time and that this morphological difference between the Recent and fossil forms is significant enough to justify naming the fossil form as a separate species. In part, this

decision to use the changes observed in varix count as a diagnostic feature at the species level is based upon the precedence of using the number, shape, and configuration of varices as a method of identifying different species and genera in the family Muricidae. This technique has been used broadly by muricid gastropod investigators (Herbert, 2005, and references therein).

Besides examining the varices on *Cirsotrema dalli*, we also abraded the external portion of an uncatalogued Recent shell in order to compare its underlying sculpture with that of its fossil counterpart.

Even though many of the epitoniids examined are in excellent shape, the task of classifying them and placing them into their appropriate generic and subgeneric groupings was challenging. This is, in part, because there is very little natural history information on Recent species that provide insight into how these animals grow and how their growth is impacted by environmental conditions. Subsequently, we have relied heavily upon the combined works of numerous past investigators to help us with this decision making process. These researchers included, but were not limited to: Brunet (1995), de Boury (1909), Clench and Turner (1950; 1951; 1952), DuShane (1979; 1988), Gardner (1947), Kilburn (1985), Nakayama (2003), Robertson (1983a; 1983b; 1993), Weil et al. (1999), and Woodring (1959).

At the generic and subgeneric levels of classification many investigators have widely divergent opinions about in which group a specific epitoniid should be placed. According to Clench and Turner (1950), de Boury's work on Epitoniidae left behind a long list of generic and subgeneric names with only the types available for diagnostic analysis. This list includes seven generic and 19 subgeneric names (Weil et al., 1999). It was Clench and Turner's (1950) opinion that de Boury became confused about the overlapping characteristics of the Epitoniidae and rather than trying to place them into existing categories, he established new genera and subgenera for them. To date, this confusion with overlapping characteristics appears to have continued with the list of generic and subgeneric extant Epitoniidae alone being expanded to 34 and 38 names, respectively (Weil et al., 1999). For our classification purposes we have decided to adhere, as closely as possible, to the more conservative phylogenetic scheme followed by Clench and Turner (1950) rather than the more recently expanded version used by Weil et al. (1999) and Nakayama (2004).

With fossils, placement of certain epitoniids into appropriate generic and subgeneric groups has been hampered by erosion (taphonomic degradation). This process removes surface sculpturing present on living specimens and exposes subsurface characteristics that are remarkably different. In this paper, an example of the impact erosion has on the external features of a shell is illustrated with the new species *Epitonium conwaiae*.

We have tried to survey all the pertinent descriptions and illustrations of both fossil and Recent epitoniids. For taxonomic comparison purposes the most significant literature came from publications dealing with the descriptions of Recent and fossil species collected from the United States, Central and South America, the northwest Atlantic, European continent, and the eastern Pacific.

Institutional abbreviations used herein are: USNM: National Museum of Natural History, Smithsonian Institution, Washington, DC; UF: Florida Museum of Natural History (FLMNH), University of Florida, Gainesville; TU: Tulane University, (formerly housed in New Orleans, Louisiana and now housed at the FLMNH); PRI: Paleontological Research Institution, Ithaca, New York; ANSP: The Academy of Natural Sciences, Philadelphia, Pennsylvania; and BMSM: The Bailey-Matthews Shell Museum, Sanibel Island, Florida. Because of privacy rights of landowners, specific locality data for specimens described below are not given. However, specific locality information is available to qualified researchers upon written request to portell@flmnh.ufl.edu.

SYSTEMATICS

Superfamily Janthinoidea Lamarck, 1812
Family Epitoniidae Berry, 1910
Genus *Amaea* H. and A. Adams, 1853

Type Species: by subsequent designation, *Scalaria magnifica* Sowerby, 1844.

Subgenus *Scalina* Conrad, 1865
Amaea gardnerae (Olsson, 1967)
(Figures 3–9)

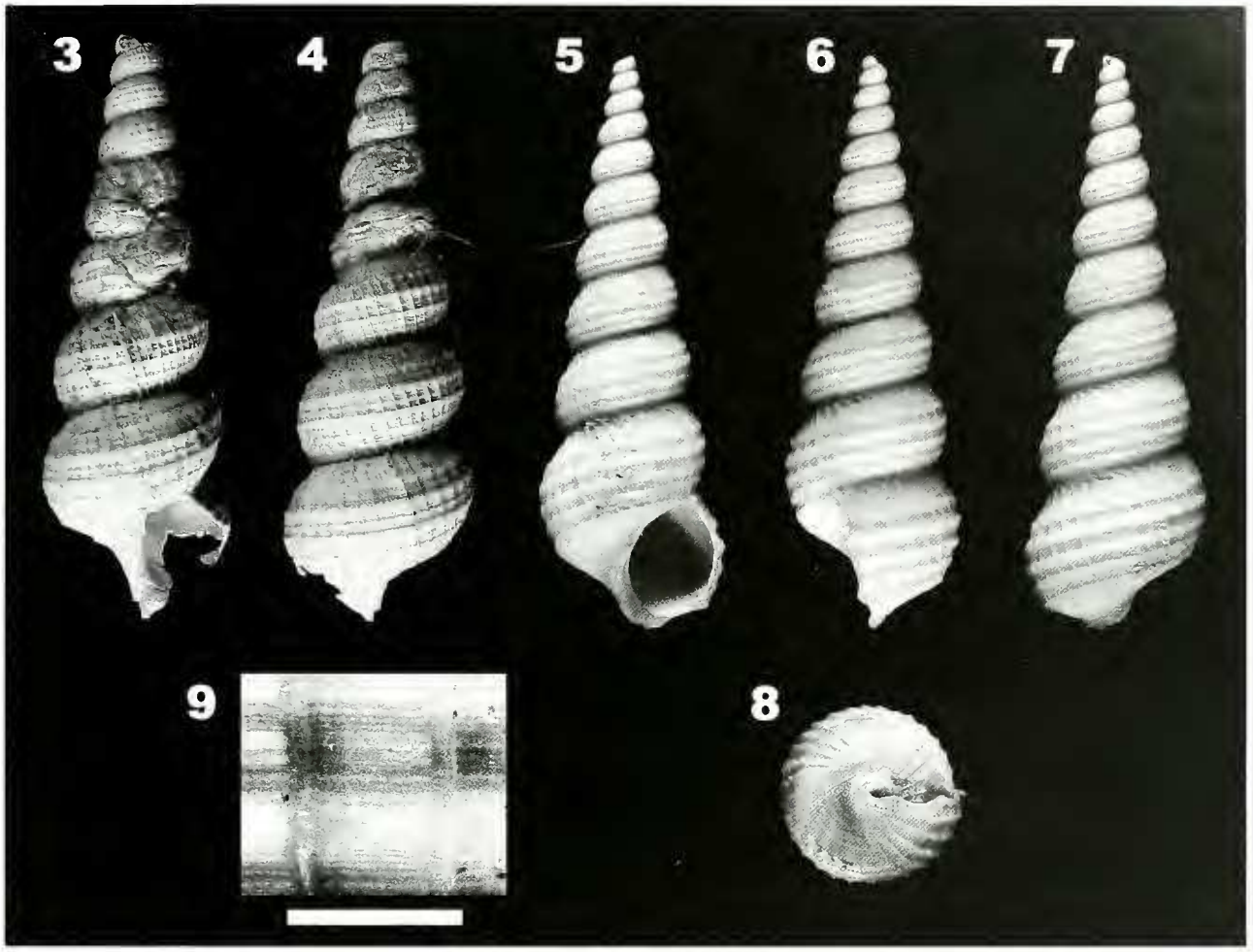
Description: Shell large, turriculate; protoconch missing; nine or ten teleoconch whorls. Spire angle 19.5°. Whorls convex, relatively thin, with cancellate sculpture. Cancellate pattern created by four spiral cords crossed by smaller, evenly spaced axial costae; square spaces within cancellate sculpture possess textured pattern created by fine overlapping axial and spiral threads. Suture deeply impressed. Basal cord well-defined, surface slightly elevated and sculptured with thin spiral and axial threads. Sculpture below basal disc lacks elevated spiral cords. Umbilicus absent.

Holotype: USNM 645180, maximum height 47.5 mm, maximum width 14.4 mm.

Type Locality: McClellan Farm, Calhoun County, Florida.

Other Material Examined: UF 117045, 1 shell, Tenmile Creek 04 (CA020) (= Tulane University locality TU 951), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 117087, 1 shell, locality and formation same as preceding; UF 91459, 16 shells, Tenmile Creek 03 (CA017) (= Tulane University locality TU 546), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Distribution: *Amaea gardnerae* is a fairly common Chipola Formation species. It is abundant at several col-



Figures 3–9. *Amaea gardnerae* (Olsson, 1967). **3–4.** Apertural and abapertural views of holotype USNM 645180 originally named *Scalina gardnerae* Olsson, 1967. Since its original description the specimen has degraded, maximum height 47.5 mm, maximum width 14.4 mm. **5–8.** Apertural, lateral, abapertural, and basal views of UF 117045 shown for comparison to holotype (USNM 645180) and other Chipola and Shoal River formation epitoniid species; maximum height 17.85 mm, maximum width 5.4 mm. **9.** Magnified view of sculpture of teleoconch of UF 117045. Scale bar = 0.6 mm.

lection sites along Tenmile Creek but is less abundant along Farley Creek and the Chipola River. Thus far, there are no reports of it having been collected along the Yellow or the Apalachicola rivers.

Etymology: Named for Julia A. Gardner, a pioneer researcher on Chipola Formation mollusks.

Discussion: Gardner (1948) reported an epitoniid fragment from the Chipola Formation which she assigned to the genus *Scalina*. Olsson (1967) later described this species as *Scalina gardnerae*. A more thorough analysis of additional specimens of *S. gardnerae* now indicates that it should be placed in the genus *Amaea*. DuShane (1988) noted that members of the genus *Amaea* are larger than any known *Scalina* and have a less distinct basal cord. In addition, DuShane observed that in the genus *Amaea*, the sculpture above and below the basal cord is different. Unfortunately, the poor condition of the type specimen described by Olsson makes it difficult to tell what the sculpturing was like in the vicinity of the basal cord. Subsequent specimens, however, have revealed that the sculpturing above and below the basal cord is different in *S. gardnerae* (Figures 5, 8).

Clench and Turner (1950), Weil et al. (1999), and Nakayama (2003) have all placed epitoniids with the shell sculpture described by Olsson (1967) for *Scalina gardnerae* into the genus *Amaea*. We are in complete agreement with this placement and have assigned Olsson's epitoniid to that genus.

Weil et al. (1999) has identified eight subgeneric forms of the genus *Amaea*. These subgenera are distinguished from one another by the types of sculpture that appear above and below the basal cord. Nakayama (2003) in his review of northwest Pacific epitoniids retained six of the subgenera listed by Weil et al. (1999). Among the six subgenera listed for the genus *Amaea* by Nakayama (2003), the present authors have assigned the Chipola Formation species to the subgenus *Scalina*. According to

Nakayama (2003) and Weil et al. (1999) members of this subgenus possess convex body whorls with a cancellate sculpture of spiral cords and axial ribs.

Representatives of the genus *Amaea* have been reported from a number of other fossil locations. These include *Scala* (*Opalia*) *reticulata* Martin, 1904, from the Miocene Calvert Formation of Maryland, *Amaea* (*Scalina*) *ferminiana* (Dall, 1908) from the Pliocene Esmeraldas beds of Ecuador, *Scala* (*Acrilla*) *wiegandi* (Böse, 1910) from Mexico and the Miocene Chagres Formation of Panama (formerly Canal Zone), *Scalina pseudolerogi* (Maury, 1925) from the Pliocene of Trinidad, *Epitonium* (*Ferminoscala*) *manabianum* (Pilsbry and Olsson, 1941), and *Epitonium* (*Ferminoscala*) *eleutherium* (Pilsbry and Olsson, 1941) from the Pliocene fauna of western Ecuador, *Scalina boylae* (Olsson, 1967) from the Pliocene Tamiami Formation of Florida, and *Scalina kendacensis* Jung, 1971, from the Miocene Kendeace Formation of Carriacou. *Amaea ferminiana*, originally described from the Recent of Baja California, is an offshore species. It ranges from Mexico south to Peru (Weil et al., 1999). DuShane (1988) considered *E. eleutherium* and *S. wiegandi* to be synonymous with *A. ferminiana* and suggested that *S. pseudolerogi* as well as some other fossil species of *Amaea* may be synonymous with *A. ferminiana*. Comparison of *A. gardnerae* with *A. ferminiana* clearly illustrates that the two species are not synonymous. *Amaea ferminiana* possesses six to nine spiral cords of uniform thickness on the body whorls, while *A. gardnerae* possesses four broad primary cords with finer cords in between. The costae on *A. gardnerae* are also less prominent then they are on *A. ferminiana*. Comparison of *Amaea mitchelli* (Dall, 1896), a Recent western Atlantic species, to *A. gardnerae* was also made. *Amaea mitchelli* has 6–7 primary spiral cords on the body whorls (four of which are closely spaced below the whorl mid-line and two to three that are evenly spaced above) as compared to *A. gardnerae* which has four evenly spaced primary spiral cords.

Genus *Cirsotrema* Mörch, 1852

Type Species: *Scalaria varicosa* Lamarck, 1822, by monotypy.

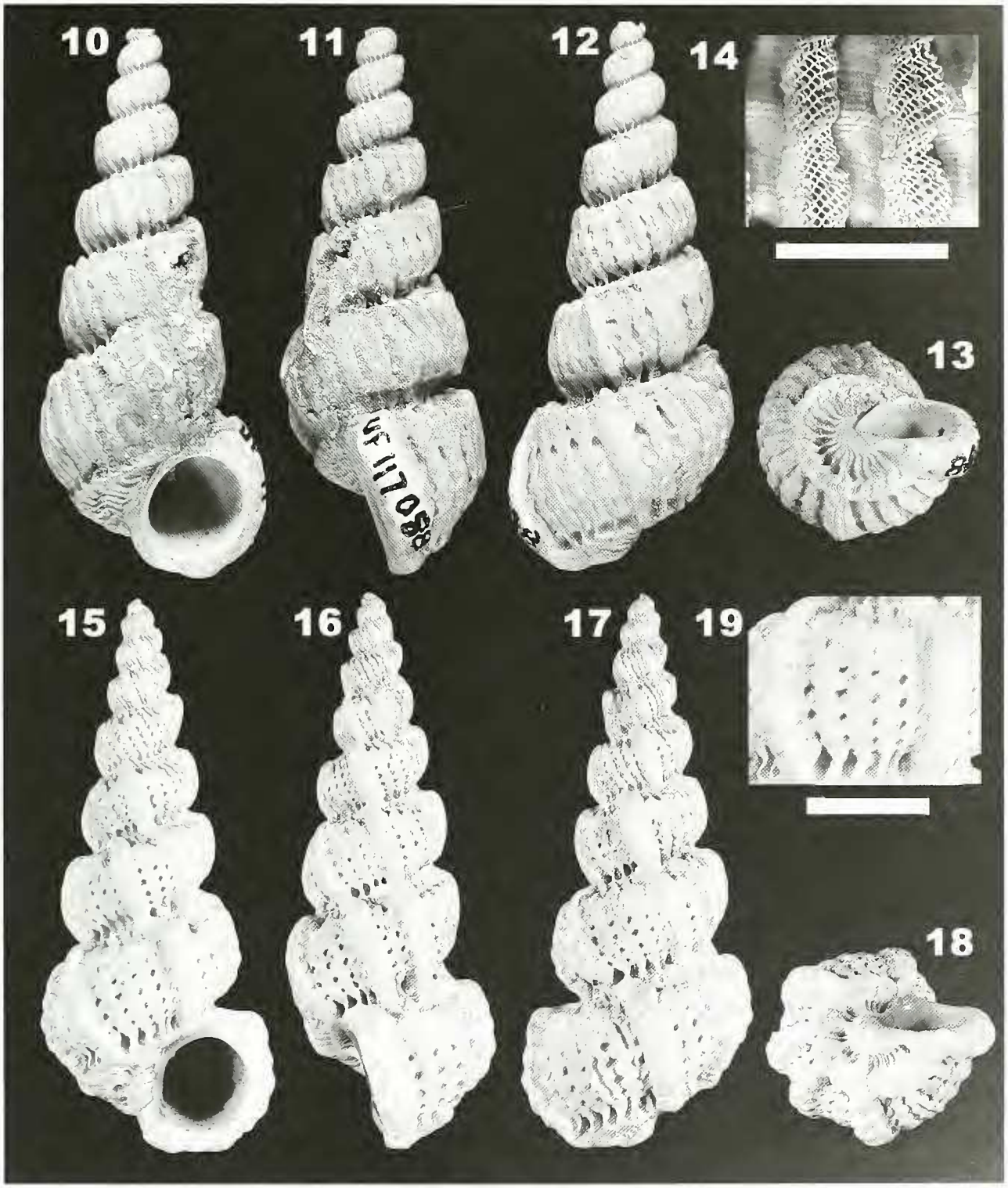
Cirsotrema chipolanum new species
(Figures 10–14)

Description: Shell large, turriculate, protoconch missing; seven to eight teleoconch whorls. Spire angle 27°. Whorls slightly convex, strongly shouldered and joined. Primary underlying sculpture present on teleoconch whorls consists of slightly elevated vertical ribs. Suture deep, covered by external sculpture. Seventeen to 23 sinuous, inclined, feather-like, broad costae on body whorls. Edges of foliated costae occasionally touch the preceding ones giving the shell surface a pitted appearance. In other instances foliated costae are slightly separated from one another. When feather-like costae separate from each other, five slightly elevated spiral cords seen on body whorls. Spiral cords, and spaces between them, possess numerous distinct spiral threads. Thin vertical threads intersect spiral threads, creating faint cancellate pattern. Varices formed from accretion of foliated costae; varices poorly developed and only slightly elevated. Apical end of costae with pointed nodes. Surface of costae pitted with obliquely arranged small holes. Three or four obliquely arranged, slightly elevated, narrow cords traverse each costa. Oblique cords on costae less pitted than remainder of surface area. Base of each costa stem-like, attached to a broad, crenulated, basal cord. Basal disk composite, created by a large outer basal cord with crenulated edges; a middle circle of narrow linear pits; and an inner columellar cord with a crenulated edge. Aperture subcircular. Columella short and arched. Lip margin thickened, pitted in unworn specimens. Less eroded specimens possess a slightly elevated node on the posterior outer margin of the lip.

Holotype: UF 117088, maximum height 32.9 mm, maximum width 15.0 mm.

Type Locality: Tenmile Creek 03 (CA017) (= Tulane University locality TU 546), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Paratypes: UF 117089, 1 shell, locality and formation same as holotype; UF 91490, 5 shells, locality and formation same as holotype; UF 84575, 7 shells, Tenmile Creek 01 (CA002) (= Tulane University locality TU 830), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 95161, 1 shell, Tenmile Creek 04 (CA020) (= Tulane University locality TU 951), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 85383, 1 shell, Chipola 09 (CA018) (= Tulane University locality TU 547), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 13966, 1 shell, Chipola 03 (CA005), Chipola River (exact collection site unknown), Calhoun County, Florida, Chipola Formation; UF 94650, 1 shell, Tenmile Creek 02 (CA003) (= Tulane University locality TU 70), Altha West Quadrangle USGS 7.5′ Series (1982), Calhoun County, Florida, Chipola Formation; UF 84444, 1 shell, Farley Creek 03 (CA009) (= Tulane University locality TU 825), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 91356, 1 shell, Chipola 07 (CA015) (= Tulane University locality TU 554), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; USNM 534489, 1 shell, Tenmile Creek 01 (CA002) (= Tulane University locality TU 830), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; USNM 534490, 2 fragments, locality and formation same as preceding; USNM 534491, 2 fragments, Tenmile Creek 05 (CA021) (= Tulane University locality TU 998), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; USNM 534492, 1 shell, Farley Creek 03 (CA009)



Figures 10–19. *Cirsotrema chipolanum* new species and *Cirsotrema dalli* Rehder, 1945. **10–13.** *Cirsotrema chipolanum*; apertural, lateral, abapertural, and basal views of holotype UF 117088; maximum height 32.9 mm, maximum width 15.0 mm. **14.** Magnified view of sculpture of teleoconch of holotype UF 117088. Scale bar = 2.85 mm. **15–18.** *Cirsotrema dalli* Rehder, 1945; apertural, lateral, abapertural, and basal views of UF 238698; maximum height 32.8 mm and maximum width 13.8 mm. **19.** Magnified view of sculpture of teleoconch of UF 238698. Scale bar = 5.0 mm. UF 238698 live collected off Egmont Key, Pinellas County, Florida at about 52 m depth.

(= Tulane University locality TU 825), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; USNM 534493, 10 shells, Tenmile Creek 03 (CA017) (= Tulane University locality TU 546 and USGS 2212 "one mile west of Bailey's Ferry"), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; USNM 534494, 8 shells, same locality and formation as preceding.

Distribution: *Cirsotrema chipolanum* is a fairly common species. It is locally abundant at several Chipola Formation collecting sites along the Chipola River and Tenmile and Farley creeks. The fact that it has not been reported from the Oak Grove Sand along the Yellow River or from Chipola Formation sites along the Apalachicola River may simply reflect the degree of difficulty collecting these localities at the appropriate periods of low water level.

Etymology: Named for the Chipola River.

Discussion: The genus *Cirsotrema* has an extensive evolutionary history. Sohl (1964) established the genus *Striaticostatum* to represent a Cretaceous form of *Cirsotrema* that lacked the faint spiral striations on the body whorl. By the Eocene the genus *Cirsotrema* was well established with numerous species being described from different localities (Dockery, 1980; Harris and Palmer, 1946; Palmer, 1937). Currently, among extant forms, two species of *Cirsotrema* exist in the western Atlantic (Weil et al., 1999). These are *Cirsotrema dalli* Rehder, 1945 and *Cirsotrema pilsbryi* McGinty, 1940.

Two species of *Cirsotrema* have also been reported from lower Miocene Chipola Formation. Olsson (1967) identified a specimen collected along the west bank of the Chipola River south of Tenmile Creek as *C. dalli* and more recently Duerr (2004) described *Cirsotrema cirritum* from material collected at several different Chipola Formation sites. Olsson (1967) stated that after close examination of the Chipola Formation *Cirsotrema* he found practically no differences between it and the extant species currently living in the western Atlantic. Since Olsson's (1967) analysis of the Chipola *Cirsotrema*, over 50 additional specimens have been collected from a variety of Chipola locations. When most of these specimens were closely scrutinized it became apparent to the present investigators that the Chipola Formation *Cirsotrema* studied by Olsson (1967) was not *C. dalli*.

As noted by Clench and Turner (1950), the sculpturing on the body whorls of representatives of the genus *Cirsotrema*, is extremely complicated. It was suggested by Clench and Turner, and observed in the present work, that two layers of sculpturing are present on the body whorls of *Cirsotrema dalli*. There is an outermost one that consists of foliated costae that may or may not join each other along their convoluted edges and a secondary layer of laminated costae and spiral cords. Because of this dual type of sculpture Clench and Turner warned against identifying different species of *Cirsotrema* from beach worn specimens.

Often with fossil specimens it is difficult to find shells that have not been eroded. However, a sufficient number of well-preserved Chipola Formation *Cirsotrema* were discovered which allowed a more detailed comparison between the fossil form of this genus and its Recent counterpart. These detailed studies lead to the following observations:

First, when the underlying sculpture of the Chipola Formation *Cirsotrema* was exposed no difference was discovered between it and the underlying sculpture exhibited by *C. dalli*.

Second, although varices are present on both the Chipola Formation *Cirsotrema* and its Recent counterpart, the varices on the Chipola Formation species are clearly not as well developed as those of Recent *C. dalli*. In fact, the varices on *C. chipolanum* are at times so poorly formed that it is difficult to identify them as varices. In *C. dalli* the costae are fused together to form a pronounced, elevated ridge (Figures 15–19) that, in well-preserved specimens, has a slightly crenulated margin. Conversely, with *C. chipolanum* the varices consist of little more than one or two slightly raised costae (see Figures 10–13). In addition, even in instances where two costae are fused together to form a varix, the fusion is often not complete and a distinct line of demarcation can be seen.

Third, when a comparison of the number of varices in relation to the height of the shell was undertaken with well-preserved specimens of *C. dalli* and *C. chipolanum*, and a least squares regression analysis was done on the two species, the results showed a significant correlation between the height of the shell and the number of varices with *C. dalli* (0.922), and a low correlation between shell height and the number of varices with *C. chipolanum* (0.499). Table 1 below provides the statistical results of this study and a comparison of the number, size range, average size, varix range, and average number of varices of the specimens used in the analysis.

As a result of the regression analysis two other differences between the varices of the two species was also noted. Although the varices appeared at random intervals on the body whorls of both species, in *C. chipolanum* the first varix did not appear until after the third teleoconch whorl, while in *C. dalli* varices would appear just after the protoconch. In addition, when the number of varices

Table 1. Results of least squares regression analysis comparing shell height with the number of varices found in *C. dalli* and *C. chipolanum*.

	C. dalli	*C. chipolanum*
No. of specimens examined	23	16
Correlation coefficient	0.922	0.499
Range of shell height (mm)	5.8–37.5	5.0–44.2
Mean height (mm)	15.31	17.21
Range of varices	2–27	0–10
Mean no. of varices	8.82	4.75

was compared between the different species it was discovered that *C. dalli*, on average, had significantly more varices than *C. chipolanum* [$\bar{X}$ = 8.82 vs. 4.75].

Table 2 below summarizes the structural differences in shell morphology between *C. dalli* and *C. chipolanum*. In addition to comparing the differences between the shape and number of varices between species, the table also compares the number of teleoconch whorls, the number and arrangement of costae, the spire angles, the arrangement of the costae, and the placement of varices on the body whorls.

Another point worth noting is that *C. dalli* and *C. chipolanum* came from very different environments. *Cirsotrema dalli* lives in cooler continental shelf waters at depths of 37 to 227 m (Clench and Turner, 1950) while *C. chipolanum* thrived in a shallow, warm, tropical, reef habitat. Although not a great deal is known about how the environment and food supply impact the growth of wentletraps [Robertson (1983a) and Weil et al. (1999)], there has been sufficient studies done on the family Muricidae (Vokes, 1973) that will allow us to speculate as to the reasons for the number and structural differences observed between the varices of *C. dalli* and *C. chipolanum*. According to Vokes (1973) varix (axial growth ridge) development in muricids occurs during resting stages in shell formation. These stoppages may come about as the result of food shortages or perhaps as the result of environmental changes. The weaker development and lower number of varices in *C. chipolanum* may indicate that this species lived in a rather stable environment where there were a large number of prey species for it to consume. Conversely, *C. dalli* has more and better developed varices (growth stoppages) which may be due to lack of prey or perhaps increased predation pressures.

In all probability, *C. chipolanum* is the ancestral form of *C. dalli*. It is the opinion of the investigators that *C. chipolanum* probably retreated from the coastal waters into the deeper offshore waters during intervening ice ages where it gradually evolved into the extant, and morphologically similar, *C. dalli*.

Clench and Turner (1950) did not assign a subgeneric name to this genus even though de Bonry (1909) did. Clench and Turner's reason for not using subgenera is not stated, but in all probability the authors did not think that structural differences between members of this genus were sufficient to warrant their use.

Since Clench and Turner's publication, Weil et al. (1999) and Nakayama (2003) have assigned a number of subgenera to the genus *Cirsotrema*. It is interesting to note that between these authors there is not complete agreement as to which subgenera are valid. For example, Nakayama (2003) used the subgenus *Borcoscala* to describe cold-water species that possess thickened, non blade-like costae, while Weil et al. (1999) raised the subgenus *Borcoscala* to the generic level. In addition, Weil et al. questions the use of *Elegantiscala* as a subgenus of *Cirsotrema* while Nakayama retained this subgenus and used it for many of the species of *Cirsotrema* he described from the northwest Pacific.

The present authors have followed the more conservative approach used by Clench and Turner (1950), Abbott (1974), Duerr (2004), and Landau et al. (2006) and have not assigned a subgenus to the new Chipola Formation species.

Cirsotrema togatum (Hertlein and Strong, 1951) is morphologically similar to *C. chipolanum*. Duerr (2004) considers *C. togatum* to be a western cognate of *C. dalli*. *Cirsotrema togatum* has also been reported from the Pliocene Esmeraldas beds of northwestern Ecuador by Pitt (1981) and DuShane (1988). *Cirsotrema chipolanum* differs from *C. togatum* in that it has fewer and less distinct spiral cords on the body whorls and the varices are much less developed.

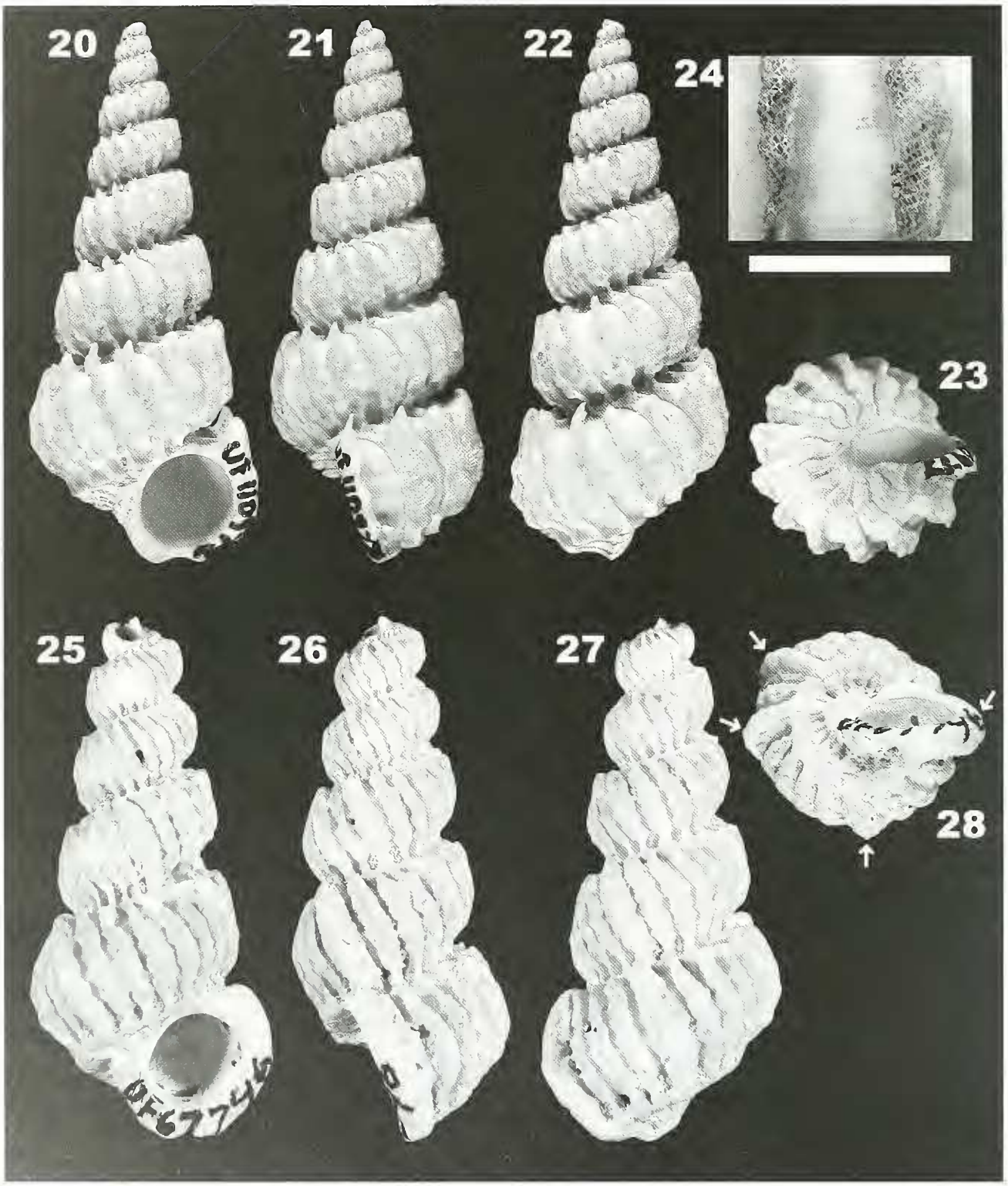
Cirsotrema woodringi Olsson, 1967, reported from the Miocene Gatun Formation of Panama and the Pliocene Tamiami Formation at Sunnyland, Florida, is similar to *C. chipolanum*. The main difference between *C. woodringi* and *C. chipolanum* is that *C. woodringi* lacks the inclined spiral sculpture that is present on the flat outer surface of the costae in *C. chipolanum*.

Table 2. A comparison of the structural differences in shell morphology between *C. dalli* and *C. chipolanum*.

	C. dalli	*C. chipolanum*
No. of specimens examined	23	16
Teleoconch whorls	9–10	7–8
Spire angle	26.5°	27.0°
Costae arrangement	touching	sometimes separated
Mean no. of costae	20.6	19.1
Range in costae number	18–23	17–21
Range in varix number	2–27	0–10
Mean varix number	8.82	4.75
Varix placement	start on 1st body whorl	start on 3rd body whorl

Cirsotrema cirritum Duerr, 2004
(Figures 20–28)

Description: Shell medium to large. Turriculate. Much of protoconch missing. Last protoconch whorl transitions from a smooth surface into wavy axial lamellae that gradually enlarge into thickened foliated costae. Spire angle 27°. Eight strongly shouldered teleoconch whorls present. Suture deep. Thirteen crenulated, recurved, axial costae present on last body whorl. Apical ends of axial costae sharp. Costae made up of multiple wavy lamella that possesses a fine irregular diamond-shaped pattern that is inclined adaperturally. Costae separated by wide intercostal spaces. Intercostal spaces possess five rounded spiral cords. Cords and intervening spaces have a cancellate sculpture created by overlapping vertical and horizontal threads. Anterior reflected projections of costae on last body whorl form a basal ridge with a crenulate outer margin. Costae on basal ridge not fused. Varices absent. Columella short and arched. Aperture subcircular. No umbilicus.



Figures 20–28. *Cirsotrema cirritum* Duerr, 2004. **20–23.** Apertural, lateral, abapertural, and basal views of holotype UF 110972; maximum height 28.5 mm, maximum width 11.8 mm. **24.** Magnified view of sculpture of teleoconch of UF 110972. Scale bar = 2.75 mm. **25–28.** Apertural, lateral, abapertural, and basal views of paratype UF 67746; maximum height 29.6 mm, maximum width 13.4 mm. **Note:** Arrows point to apparent varices on paratype UF 67746; thus based upon description by Duerr (2004, p. 454–155) denoting a key diagnostic feature of no varices, this paratype was mistakenly identified. In our opinion UF 67746 is representative of *C. chipolanum* new species.

Holotype: UF 110972, maximum height 28.5 mm, maximum width 11.8 mm.

Type Locality: Tenmile Creek 01 (CA002) (= Tulane University locality TU 830), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation. Note: Duerr (2004) erroneously listed the GPS coordinates of 29° 30.05′ N, 85° 11.00′ W for this locality and provided no datum. These coordinates are approximately 17 km south of Saint Vincent Island, Florida in the Gulf of Mexico. Additionally, Duerr (2004) listed the type locality as in the SE1/4 of Sec. 7. It should have read SE1/4 of Sec. 12.

Other Material Examined: UF 112019, paratype, Farley Creek 03 (CA009) (= Tulane University locality TU 825), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 67746, paratype, locality and formation same as preceding; BMSM 15301, paratype, Tulane University locality TU 458, Chipola Formation; USNM 534499, 2 shells, Tenmile Creek 03 (CA017) (= Tulane University locality TU 546), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Etymology: The name *cirritum* is derived from the Latin *cirrus* meaning "filamentous" which refers to the fringed costae of this species.

Discussion: One of the key diagnostic features of *C. cirritum* is its lack of varices. However, when comparing the paratypes of *C. cirritum* with the holotype, one paratype, identified as *C. cirritum*, was discovered to possess varices that were similar to those observed in *C. chipolanum* (see Figures 25–28). This discovery generated some confusion and resulted in an exhaustive investigation to determine if only one species of *Cirsotrema* (*C. cirritum*) existed in the Chipola Formation or if there were two distinct species and a mistake had been made with the selection of one of the paratypes of *C. cirritum*. The conclusion drawn from this analysis was that there are two different species of *Cirsotrema* in the Chipola Formation and that the *C. cirritum* paratype (UF 67746) was mistakenly selected.

When examining the different species of the Chipola Formation *Cirsotrema* it is easy to see how this mistake occurred. The varices on *C. chipolanum* sometimes can be easily overlooked without careful examination under a microscope. A summary of differences between *C. cirritum* and *C. chipolanum* is found in Table 3.

Table 3. A comparison of the structural differences in shell morphology between *C. cirritum* and *C. chipolanum*.

	C. cirritum	*C. chipolanum*
Mean varix number	0	4.75
Costae number	13	17–21
Foliated costae	widely separated	closely packed
Basal ridge	costae not fused	costae fused

Cirsotrema cirritum is a fairly rare species that has been obtained from only three fossil localities; one each on the Chipola River (TU locality 458), Tenmile Creek (TU locality 951), and Farley Creek (TU locality 825).

As Duerr (2004) noted, *C. cirritum* is a fairly distinctive species that bears some resemblance to several types of Recent Indo-Pacific Epitoniidae. Among the comparable Recent species, Duerr (2004) reported were *Cirsotrema plexis* Dall, 1925, *Cirsotrema fimbriatulum* (Masahito et al., 1971), *Cirsotrema rugosum* (Kuroda and Ito, 1961), and *Cirsotrema excelsum* Garcia, 2003.

Among fossil species *C. cirritum* is most similar to the Miocene species *Cirsotrema undulatum* (Jung, 1965) from the Paraguaná Peninsula, Venezuela. *Cirsotrema undulatum* is a medium-size shell with six to eight postnuclear whorls that possess thin, widely spaced axials (Jung, 1965). *Cirsotrema cirritum* differs from *C. undulatum* by having fewer axial costae on the body whorls (13 versus 17–21) and five spiral cords on each body whorl versus four.

The presence of two species of *Cirsotrema* in the tropical Chipola Formation environment is consistent with what currently exists in Florida offshore waters today. According to Clench and Turner (1950), both *C. dalli* and *C. pilsbryi* can currently be found in deep water off the Florida coast.

Genus *Opalia* H. and A. Adams, 1853

Type Species: by subsequent designation, *Scalaria australis* Lamarck, 1822.

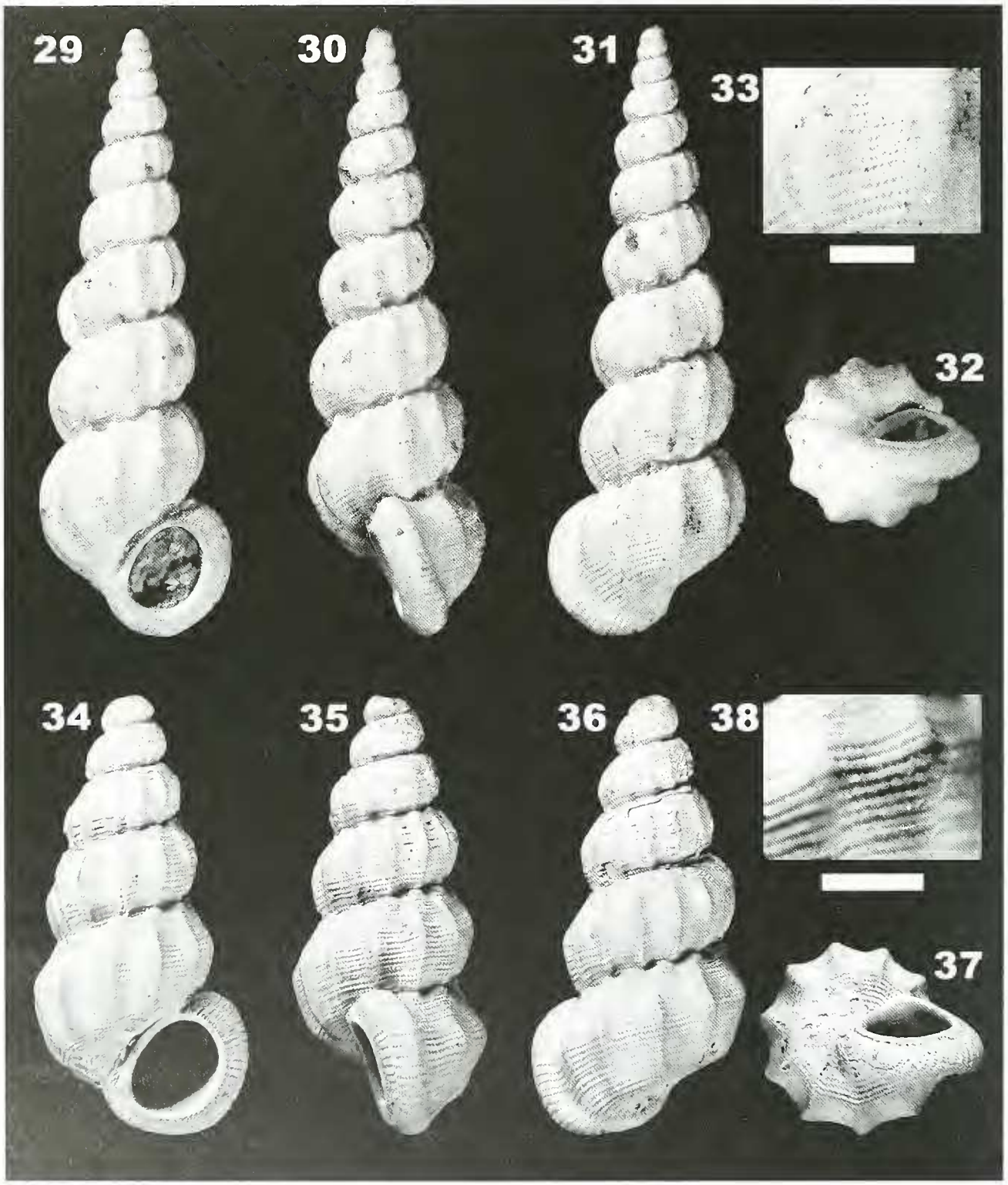
Subgenus *Nodiscala* de Boury, 1889
Opalia politesae new species
(Figures 29–33)

Description: Shell small, slender; 2.5 smooth protoconch whorls, 8 convex teleoconch whorls. Spire angle 20°. Twelve to 13 rounded axial costae on last teleoconch whorl. Shell surface covered with fine horizontal and vertical threads giving surface a pitted appearance. Pitted surface absent on distal surface of axial costae. Costae terminate at the suture, creating a crenulated ridge. Sutures moderately impressed. No basal ridge present. No varices. Aperture oblique, subcircular, surrounded by thick rounded lip. Inner portion of lip encircled by a thin, unsculptured rim. Outer portion possesses fine vertical threads that radiate outwards towards periphery. No umbilicus. Columella short and arched.

Holotype: UF 114913, maximum height 5.5 mm, maximum width 1.7 mm.

Type locality: Tenmile Creek 03 (CA017) (= Tulane University locality TU 546), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Paratypes: USNM 534495, USNM 534496 and UF 113897, 1 shell each, protoconchs missing, locality and formation for each specimen the same as holotype; USNM 534497, 1 shell, protoconch missing, Tenmile



Figures 29–38. *Opalia politesae* new species and *Opalia mica* new species. **29–32.** *Opalia politesae*; apertural, lateral, abapertural, and basal views of holotype UF 114913; maximum height 5.5 mm, maximum width 1.7 mm. **33.** Magnified view of sculpture of teleoconch of UF 114913. Scale bar = 0.41 mm. **34–37.** *Opalia mica*; apertural, lateral, abapertural, and basal views of holotype UF 66077; maximum height 4.0 mm, maximum width 1.5 mm. **38.** Magnified view of sculpture of teleoconch of UF 66077. Scale bar = 0.34 mm.

Creek 01 (CA002) (= Tulane University locality TU 830), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 67499, 3 shells, Chipola 01 (McClelland's Farm) (CA001) (= Tulane University locality TU 457), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 114914, 2 shells, locality and formation same as holotype; UF 114922, 3 shells, Tenmile Creek 04 (CA020) (= Tulane University locality TU 951), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Distribution: Although *Opalia politesae* is one of the more common epitoniids found in the Chipola Formation, its distribution appears limited to the reef paleoenvironments found along Tenmile Creek and the Chipola River.

Etymology: Named for Greta Polites, an avid student and collector of Chipola and Shoal River formation fossils.

Discussion: According to Clench and Turner (1950: 231) members of the genus *Opalia* have "Spiral sculpture usually of exceedingly fine incised threads which may or may not be finely pitted." In addition, the genus also possesses relatively low, heavy costae, no umbilicus, and a thick outer lip divided into a thin inner unsculptured ring and a thicker finely pitted one. In the subgenus *Nodiscala* the sutures are crenulated and the basal cord is absent.

Gardner (1947) reported the subgenus *Nodiscala* from Eocene deposits in Australia. However, there is no evidence of the genus *Opalia* from the Eocene of the United States. MacNeil and Dockery (1984) reported a number of different species of *Opalia* from the lower Oligocene Mint Spring Formation of Mississippi. According to Gardner (1947: 578), the subgenus *Nodiscala* is "peculiarly characteristic of the Miocene of central Europe" and she also noted that several species have been found in the Pliocene of Italy. Landau et al. (2006) reported a number of fossil *Nodiscala* from a wide range of European localities. These fossils have been found in deposits that date from the early Miocene to the late Pleistocene. DuShane (1979) lists *Opalia borealis* as possibly coming from Miocene deposits of the northeastern Pacific region. All of the remaining *Opalia* studied by DuShane (1979) came from Pliocene and Pleistocene formations. In the Caribbean, Maury (1917) reported a single specimen of *Epitonium textuvestitum* from Pliocene deposits in Santo Domingo (Dominican Republic). The description of this species given by Maury (1917) clearly indicates that it belongs to the genus *Opalia*. Both Campbell (1993) and Petuch (1994) have assigned this species to the genus *Opalia*. Campbell's specimen came from Pliocene deposits in Hampton, Virginia and Petuch's specimen was reported from the Pliocene deposits of the former APAC shell pits in Sarasota, Florida.

Opalia politesae is one of the more abundant species of Epitoniidae in the Chipola Formation where it is a unique representative of this genus. In overall contour and shape it bears some resemblance to the fossil *O. textuvestitum* but it lacks varices and has fewer costae on the body whorl. Among Recent species *O. politesae* is most similar to *Opalia burryi*, which ranges from south Florida through the West Indies to Trinidad. However, *O. politesae* is a much smaller and more slender species that has fewer body whorls (8 versus 9–11) and fewer costae on the body whorls (12–13 versus 14) than its Recent counterpart. The close similarity between *O. politesae* and *O. burryi* suggests that *O. politesae* is probably the ancestral form of *O. burryi*.

Opalia mica new species
(Figures 34–38)

Description: Shell short, stocky; one smooth protoconch whorl present, four teleoconch whorls. Nine to ten costae on last teleoconch whorl. Spire angle 29°. Costae sharply angulated, forming a node at the periphery of the body whorl. Shell surface crossed with fine horizontal and spiral threads that give the surface a pitted appearance. Pitted sculpture covers entire surface of axial costae. Costae terminate at the suture creating a crenulated ridge. Sutures moderately impressed. No basal ridge present. No varices. No umbilicus. Aperture oblique, subcircular, surrounded by a thick lip. Inner portion of lip encircled by thin, smooth rim. Outer part of lip possesses fine vertical threads that radiate outward towards the periphery. Vertical threads on lip overlapped by fine threads that give the lip a pitted appearance. Columella short and arched.

Holotype: UF 66077, maximum height 4.0 mm, maximum width 1.5 mm.

Type Locality: Shoal River Grotto (WL004) (= Tulane University locality TU 69A), New Harmony Quadrangle USGS 7.5′ Series (1987), Walton County, Florida, Shoal River Formation.

Paratypes: UF 114924, 1 specimen, and UF 88160, 3 specimens, locality and formation same as holotype.

Distribution: *Opalia mica* is a rare species but thus far has only been obtained from the type locality.

Etymology: Name alludes to its diminutive size.

Discussion: *Opalia mica* is structurally very different from *O. politesae*. It is broader and smaller than the Chipola Formation species and possesses sharply angulated costae. Gardner (1947) reported fragments of this species from the Shell Bluff location along the Shoal River in Walton County, Florida. The most comparable fossil form to *O. mica* is the Miocene species *Opalia* cf. *scacchi* (Hoernes, 1856) reported from Austria (Nordsieck, 1972). In size and overall form the two species are very similar; however, *O. mica* has deeper sutures, lacks rounded varices, and does not possess the sutural spiral cords present in the European taxon.

Among extant forms *O. mica* is similar to *O. pumilio*

morchiana Dall, 1889. Both the Chipola Formation and Recent species are small and have costae that are sharply angulated at the periphery of the body whorl. However, *O. mica* lacks varices, has a more acute spire angle (29° versus 37°), and only has four teleoconch whorls compared to seven for *O. pumilio morchiana*.

Genus *Epitonium* Röding, 1798

Type Species: by subsequent designation, *Turbo scalaris* Linnaeus, 1758.

Subgenus *Asperiscala* de Boury, 1909
Epitonium virginiae (Maury, 1910)
(Figures 39–46)

Description: Shell small, attenuate; 3 smooth, glossy, protoconch whorls, 6–7 convex teleoconch whorls separated by deep sutures. Spire angle 35°. 8–9 costae on last teleoconch whorl. Costae prominent, blade-like, slightly oblique with coronate shoulders. Fine spiral threads on body whorl crossed by faint axial growth line. No varices. Umbilicus absent. No basal cord. Aperture oval.

Holotype: PRI 3467 (formerly in Cornell University collection), maximum height 3.75 mm, maximum width 1.5 mm.

Other Material Examined: UF 95695, 1 shell, Chipola 13 (CA027) (= Tulane University locality TU 458), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 89251, 4 shells, Chipola 28 (CA066) (= Tulane University locality TU 548), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 103784, 1 shell, Tennile Creek 06 (CA023) (= Tulane University locality TU 456), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 72341, 1 shell, Shoal River Grotto (WL004) (= Tulane University locality TU 69A), New Harmony Quadrangle USGS 7.5′ Series (1987), Walton County, Florida, Shoal River Formation.

Type Location: Bailey's Ferry, Calhoun County, Florida.

Distribution: *Epitonium virginiae* is one of the more common species of Epitoniidae found in the Chipola Formation. It is also found in the Shoal River Formation where it appears to be extremely rare. A total of 59 specimens of *E. virginiae* were examined from ten Chipola Formation collection sites in Calhoun and Liberty counties. The only Shoal River example of *E. virginiae* was obtained from UF locality WL004 (= TU 69A) in Walton County.

Etymology: Unknown.

Discussion: Members of the genus *Epitonium* are small, thin, generally slender turriculate shells with a wide range of different sculptured characteristics. Some have body whorls that are attached while others do not. A basal ridge may be present or absent, the costae may be thin and blade-like or thick and rounded, and spiral sculpturing may or may not be present. This high degree of structural variability within the genus has caused researchers to organize its members into numerous subgenera.

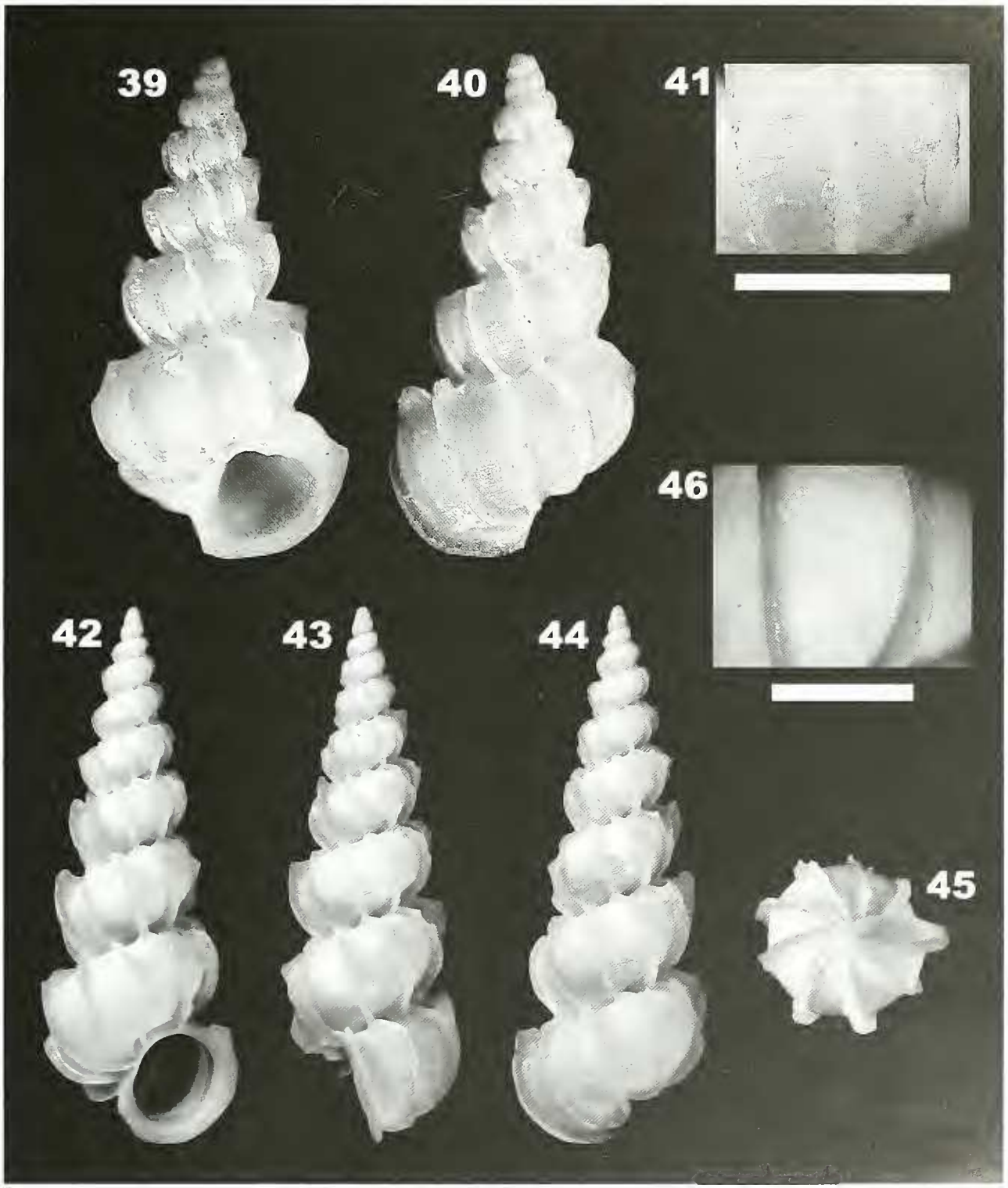
Epitoniidae with blade-like costae, spiral thread-like cords on the body whorls, and an absence of a basal ridge were assigned to the subgenus *Asperiscala* by de Boury (1909). Members of the subgenus *Asperiscala* have been reported from deposits as old as Cretaceous (Wade, 1926).

Clench and Turner (1952) kept the subgenus *Asperiscala* and assigned to it all epitoniids with spiral cords and either blade or cord-like costae. DuShane (1979: 91), because of "Certain morphological differences from those of *Epitonium s.s.*", elevated *Asperiscala* to full generic rank when she described the family Epitoniidae in the northeastern Pacific. According to Kilburn (1985), however, the type species of *Asperiscala* is not representative for this taxon. Kilburn reported that the type species of *Asperiscala* described by de Boury (1909) had cancellate sculpture. Subsequently, Kilburn assigned epitoniids with only spiral sculpture to the subgenus *Parviscala*. Weil et al. (1999) and Nakayama (2003) retained *Asperiscala* as a subgenus but limited its use to epitoniids that resembled *Parviscala* that have an open umbilicus and sutures with peaked costae. Herein, we have retained the use of *Asperiscala* in the sense of Clench and Turner (1952), pending resolution of the problems cited above. But unlike its use in Weil et al. and Nakayama, *Asperiscala* is herein used to represent members of the genus *Epitonium* that have spiral sculpture that may or may not be intersected with faint axial threads or narrow cords.

A more detailed analysis of larger specimens of *E. virginiae* revealed the presence of fine vertical lines that intersect the slender spiral threads on the body whorls (Figure 46). The absence of this feature in Maury's description was more than likely due to the small size of the specimen she examined.

Of all the Chipola Formation species of *Epitonium* examined, only *E. virginiae* was encountered in the younger Shoal River Formation. It is apparently a rare species in this unit given that numerous collecting trips to several different Shoal River Formation sites by different collectors have yielded just one specimen. Close examination of this specimen revealed that its shell structure is fundamentally the same as that of the Chipola Formation species.

Several fossil species similar to *E. virginiae* have been collected from different localities including the Caribbean, Central and South America, and Spain. *Epitonium* (*Asperiscala*) *venezuelense* (Weisbord, 1962) from the upper Miocene Mare Formation of northern Venezuela comes closest in overall morphological characteristics to *E. virginiae*. Both species have prominent blade-like, slightly oblique costae with coroneted shoulders, and both have spiral threads in the interspaces between the axial costae that are crossed by fine axial filaments. The



Figures 39–46. *Epitonium virginiae* (Maury, 1910). **39–40.** Apertural and abapertural views of holotype PRI 3467; maximum height 3.75 mm, maximum width 1.5 mm. **41.** Magnified view of sculpture of teleoconch of PRI 3467. Scale bar = 1.0 mm. **42–45.** Apertural, lateral, abapertural, and basal views of UF 95695; maximum height 6.9 mm, maximum width 2.45 mm. **46.** Magnified view of sculpture of teleoconch of UF 95695. Scale bar = 0.55 mm.

two species differ from one another in that *E. virginiae* has more impressed sutures, the costae of *E. virginiae* do not become obsolescent near the posterior suture, and the angle of the spire is slightly wider in *E. virginiae* (35° versus 32°).

Other fossil species similar to *E. virginiae* include *Epitonium loripanum* Pilsbry and Olsson, 1941, from the Pliocene of Ecuador, *Epitonium amosbrowni* Pilsbry, 1921, from the Miocene of the Dominican Republic, *Epitonium* cf. *gabbi* (de Boury) Woodring, 1959, from the Gatun Miocene of Panama (Canal Zone), and *Epitonium muiricatoides* (Sacco, 1891) from the early Pliocene of Spain. The Chipola Formation species differs from *E. amosbrowni*, which has 16 axial costae on the last whorl versus 8–9 for *E. virginiae*, from *E.* cf. *gabbi*, which has more pronounced and numerous spiral threads on its body whorls, and *E. muiricatoides*, which lacks spiral cords on the body whorls.

A close comparison of *E. loripanum* with *E. virginiae* suggests that they may be the same species. Both have the same body shape, the presence of faint spiral threads on the body whorls, the same number of teleoconch whorls, thin ribs with coronated shoulders, and lack an umbilicus.

Among extant species, *E. virginiae* is most similar to *Epitonium denticulatum* (Sowerby, 1844). However, *E. virginiae* is more slender and has fewer axial costae.

Epitonium incomitatum new species
(Figures 47–51)

Description: Shell small, thin, turriculate. Protoconch missing; 6 strongly convex teleoconch whorls separated by deep sutures. Spire angle 31°. Thin, low, reflected costae on last teleoconch whorl numbering 24. Costae on each succeeding whorl slightly offset from the one above. Numerous spiral cords on body whorl. No varices. No basal ridge. Umbilicus present. Outer lip of aperture thin. Aperture suboval.

Holotype: UF 91452, maximum height 5.0 mm, maximum width 2.2 mm.

Type Locality: Tenmile Creek 03 (CA017) (= Tulane University locality TU 546), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Distribution: Only known from the type locality.

Etymology: The name is derived from the Latin word *incomitatus* meaning unaccompanied or alone. It refers to the unique specimen (holotype).

Discussion: *Epitonium incomitatum* is an extremely fragile shell. In shell sculpture it is similar to *Parviscala*, a subgenus retained by Weil et al. (1999) and Nakayama (2003). Gardner (1947) reported a fragment of this shell in the Chipola Formation and assigned it to the subgenus *Crisposcala*. A fragment similar to *E. incomitatum* was also reported from the upper part of Gatun Formation in Panama (Canal Zone). Woodring (1959) tentatively identified this species as *Epitonium rushii* (Dall, 1889). Weil et al. listed *E. rushii* as synonym of *Epitonium striatissimum* Monterosato, 1878. Among fossil western European species *E. incomitatum* is most similar to *Epitonium pulchellum* (Bivona, 1832) which has been reported from the middle Miocene in Italy (Cavallo and Repetto, 1992). *Epitonium incomitatum* differs from its European counterpart by having less elevated varices and less prominent spiral cords on the body whorls.

Among extant species, *E. incomitatum* is most similar to *E. striatissimum*, a rare species found in shallow water off Cape Hatteras. *Epitonium incomitatum* differs from *E. striatissimum* in that the body whorls are more inflated (the angle formed with the spire is 31° versus 25° for *E. striatissimum*) and the spiral cords on the body whorl are much broader and less numerous.

Epitonium incomitatum also bears some resemblance to *Epitonium multistriatum* Say, 1826, a species that ranges from Massachusetts to Texas. It differs from this species by possessing more numerous costae on the last body whorl (25 versus 16–19) and by having broader spiral cords on the body whorls. In addition, in *E. incomitatum* the costae are less abundant in the early whorls, while *E. multistriatum* the costae are more numerous in the early whorls (as many as 43 in some specimens).

Epitonium regina new species
(Figures 52–56)

Description: Shell small, turriculate; three smooth, glossy protoconch whorls, eight slightly angular body whorls separated by a moderately deep suture. Spire angle 23°. Eleven narrow, low, slightly reflected costae on last teleoconch whorl. Costae occasionally offset with costae on preceding whorl. Numerous faint, spiral cords on body whorls intersected by faint spiral threads. No basal cord. No umbilicus. No varices. Aperture thin, suboval.

Holotype: USNM 534487, maximum height 6.1 mm, maximum width 2.1 mm.

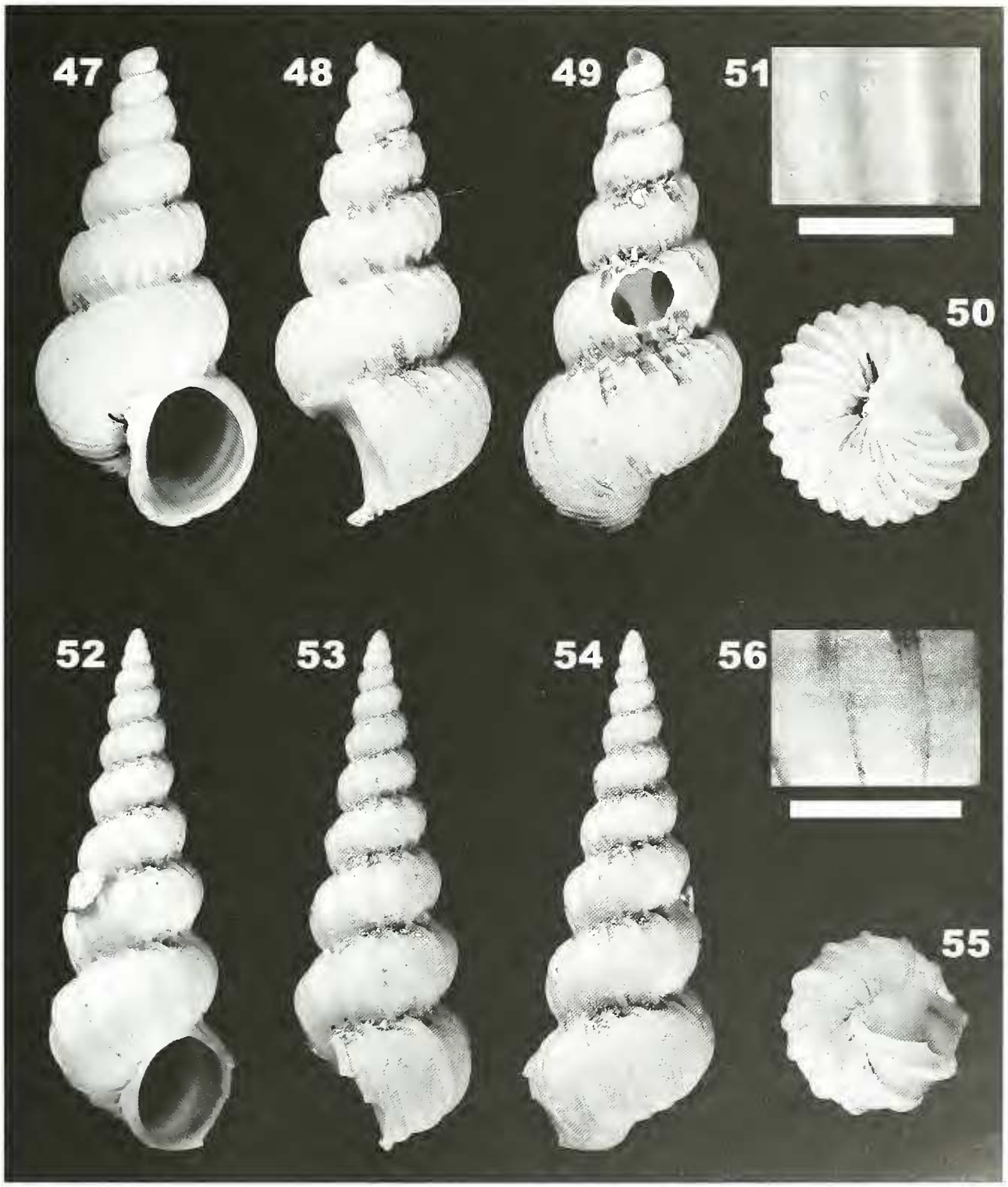
Type Locality: Farley Creek 03 (CA009) (= Tulane University locality TU 825), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Paratype: UF 67498, 1 specimen, Chipola 01 (CA001) (McClelland's Farm) (= Tulane University locality TU 457), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Distribution: Collected only from the type locality.

Etymology: Named from the Latin word *regina*, meaning queen, an allusion to the stately appearance of this species.

Discussion: Among Recent species, *E. regina* bears a slight resemblance to *Epitonium obliquum* (Sowerby, 1847), however *E. regina* has a cancellate pattern be-



Figures 47–56. *Epitonium inconitatum* new species and *Epitonium regina* new species. **47–50.** *Epitonium inconitatum*, apertural, lateral, abapertural, and basal views of holotype UF 91452; maximum height 5.0 mm, maximum width 2.2 mm. **51.** Magnified view of sculpture of teleoconch of UF 91452. Scale bar = 0.41 mm. **52–55.** *Epitonium regina*: apertural, lateral, abapertural, and basal views of holotype USNM 534487; maximum height 6.1 mm, maximum width 2.1 mm. **56.** Magnified view of sculpture of teleoconch of USNM 534487. Scale bar = 0.65 mm.

tween costae on the body whorls, lacks elevated costae near the sutures, and has no umbilicus.

Among fossil species *E. regina* bares some resemblance to *Epitonium smithfieldensis* Mansfield, 1929 and *Epitonium dupliniana* (Olsson, 1916). *Epitonium smithfieldensis* was reported from the Pliocene Yorktown Formation of Virginia. Like the Chipola Formation species it is ornamented with marginally reflected slender varices and the number of varices on the last body whorl is 12. However, *E. smithfieldensis* does not have any spiral sculpture and its varices are united at the suture. *Epitonium dupliniana* was reported from the middle Pliocene Duplin Formation of North Carolina (Olsson, 1916). Like *E. regina*, it has a thin shell with low varices and spiral sculpturing on the body whorls that is intersected by vertical threads. It differs from the Chipola Formation species in that the varices on *E. regina* are broader and more cord-like than they are in *E. dupliniana*. Also, the upper shoulder on each of the varices of *E. dupliniana* has a small hook-like projection, a feature not present on the varices of *E. regina*.

Subgenus *Epitonium* Röding, 1798

Type of Subgenus: *Tubo scalaris* Linnaeus, 1758 by subsequent designation, Suter, 1913.

Epitonium conwaiae new species
(Figures 57–66)

Description: Shell small, attenuate; 3.5 smooth protoconch whorls. Spire angle 30°. Six-and-a-half moderately convex teleoconch whorls separated by a depressed suture. Seven to nine low, moderately broad, T-shaped costae on last body whorl. Costae gradually increase in width as aperture approached. Costae angled at shoulders. Body whorls smooth but eroded specimens exhibit numerous, fairly broad spiral cords on body whorls. No basal cord, umbilicus, or varices. Aperture suboval, outer lip slightly expanded and thickened.

Holotype: UF 113894, maximum height 3.2 mm, maximum width 1.2 mm.

Type Locality: Shoal River Grotto (WL004) (= Tulane University locality TU 69A), New Harmony Quadrangle USGS 7.5′ Series (1987), Walton County, Florida, Shoal River Formation.

Paratypes: UF 67208, 9 shells, Shell Bluff 01 (WL002) (= Tulane University locality TU 69), New Harmony Quadrangle USGS 7.5′ Series (1987), Walton County, Florida, Shoal River Formation; UF 89549, 1 shell, locality and formation same as preceding; UF 117092, 2 shells, locality and formation same as preceding; UF 89638, 29 shells, locality and formation same as preceding; UF 72340, 1 shell, locality and formation same as holotype; UF 88170, locality and formation same as holotype.

Distribution: *Epitonium conwaiae* is known only from the type locality and from the Shell Bluff on Shoal River.

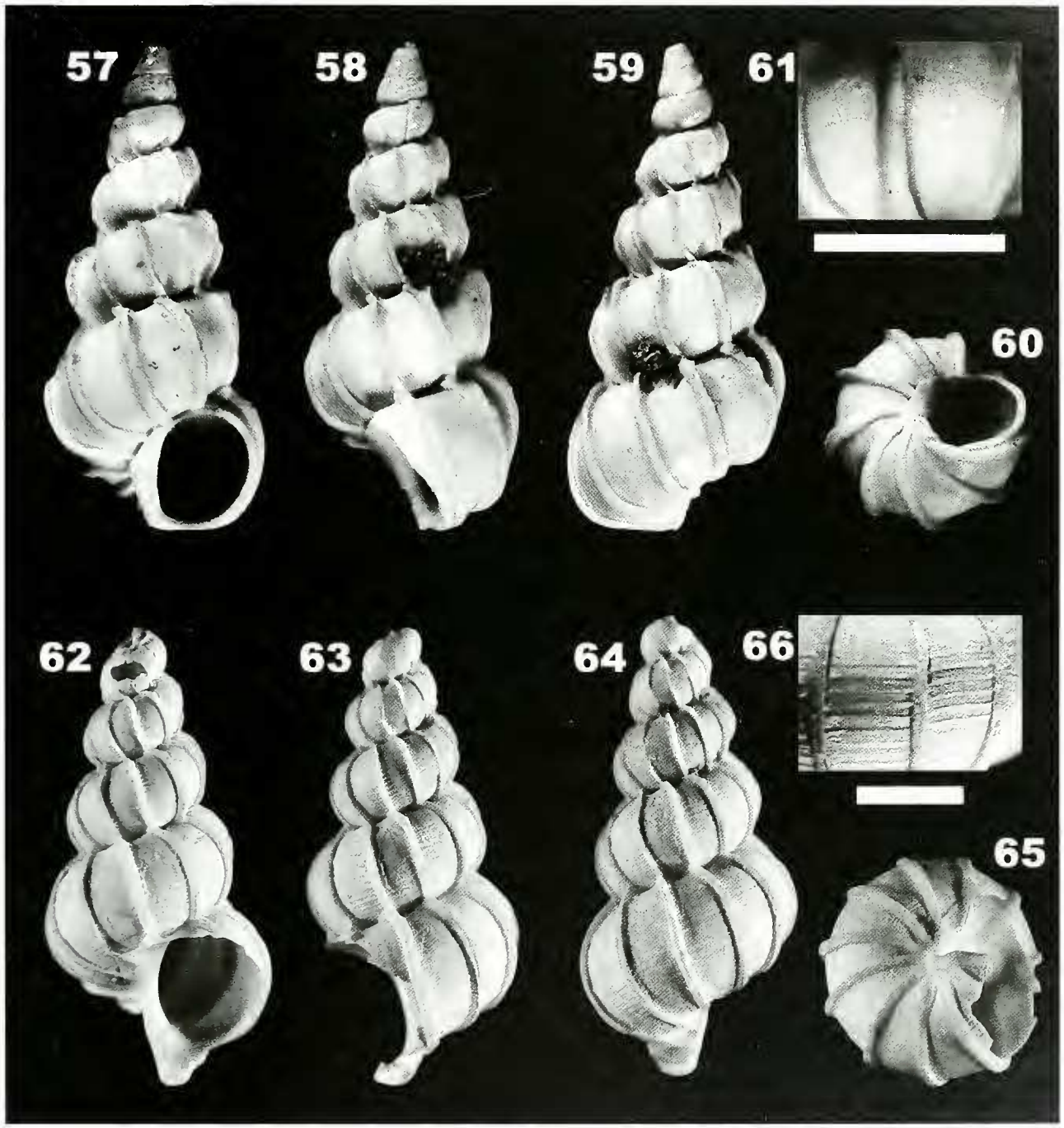
Etymology: Named for Wendy Conway a long time field associate of the authors and an avid collector of Chipola and Shoal River formation fossils.

Discussion: *Epitonium* with and without an umbilicus and possessing smooth body whorls and no basal cord were assigned to the subgenus *Epitonium* by Clench and Turner (1951). Later researchers, including Weil et al. (1999) and Nakayama (2003) subdivided *Epitonium* with smooth body whorls into a number of subgenera. For example, those with smooth body whorls, no umbilicus, and peaked costae were assigned to the subgenus *Hirtoscala*, while *Epitonium* with smooth body whorls, peaked costae and a slit-like umbilicus were placed into the subgenus *Lamelliscala*. Additionally, those with smooth body whorls, no umbilicus, and thick costae were assigned to the subgenus *Nitidiscala*.

Although probably in the minority, we find the need for splitting out the genus *Epitonium* into so many additional subgenera based upon minor morphological differences probably counterproductive to the establishment of a more realistic classification system. Clench and Turner (1951) warned researchers about this problem when they reported the difficulties de Boury experienced with his attempts to split out different members of the family. Rather than add to the confusion that exists with this taxonomic group, we have reverted to using the broader subgeneric name of *Epitonium* as defined by Clench and Turner (1951).

When compared to Recent species, non-eroded specimens of *Epitonium conwaiae* (Figures 57–61) are most similar to *Epitonium humphreysii* Kiener, 1838, which ranges from Cape Cod Massachusetts south to Florida (excluding the Florida Keys) and into the Gulf of Mexico from Cape Romano to Texas. Fossil specimens of *E. humphreysii* have also been reported from upper Miocene deposits of the Entrerriense Formation of the Chubut Province, Argentina (Brunet, 1995). Both the Shoal River Formation species and its Recent and fossil counterpart have flattened costae which are variable in width, both lack sculpturing on the body whorls, and each species has a similar number of costae on the last body whorl. The Shoal River Formation species differs from *E. humphreysii* by having more deeply impressed sutures, more angular costae on the shoulder of the body whorls, and much smaller average size.

In eroded specimens of *E. conwaiae* (Figures 62–66), the body whorls reveal a sculpture of broad spiral cords most similar to *Epitonium championi* Clench and Turner, 1952, a rare epitoniid that inhabits intertidal and near-shore waters from Cape Cod to North Carolina. Both the Shoal River Formation form and *E. championi* have flattened, cord-like costae which are variable in width and both have spiral sculpturing which consists of numerous flattened spiral cords. The Shoal River Formation species, however, differs from *E. championi* by having more deeply impressed sutures, a greater number of costae on the last body whorl (11 versus 8 or 9) and a



Figures 57–66. *Epitonium conwaiae* new species. **57–60.** Apertural, lateral, abapertural, and basal views of holotype UF 113894; maximum height 3.2 mm, maximum width 1.2 mm. **61.** Magnified view of sculpture of teleoconch of UF 113894. Scale bar = 0.7 mm. **62–65.** Apertural, lateral, abapertural, and basal views of paratype UF 72340; maximum height 4.2 mm, maximum width 2.0 mm. **61.** Magnified view of sculpture of teleoconch of UF 72340. Scale bar = 1.26 mm. UF 72340 is an eroded specimen figured here to compare sculptural differences between it and unworn holotype UF 113894.

greater angle between the spire and the outer shoulders of the shell (30° versus 20°).

Among fossil species, well-preserved specimens of *E. conwaiae* are most similar to *Epitonium boltoni* Gardner, 1948, from the Pliocene Tar River deposits in North Carolina. Like *E. conwaiae*, *E. boltoni* possesses smooth spiral whorls, has thickened slightly raised costae and lacks an umbilicus and basal cord. However, *E. conwaiae* differs from *E. boltoni* by having more impressed sutures, more angular costae on the dorsal surface of each body whorl and fewer numbers of costae on the last body whorl (9 versus 12).

The eroded form of *E. conwaiae* also bears some similarities to *Epitonium alaquaense* collected and described by Mansfield (1935) from the late Miocene strata of Vaughan Creek in Walton County, Florida. Gardner (1947: 577) reported collecting a partial specimen from Walton County from "a horizon that was slightly higher than the typical Shoal River formation." These investigators were not able to locate Gardner's shell fragment but were able to borrow Mansfield's holotype (USNM 373149) for comparative purposes (see Figures 67–68). Unfortunately, the holotype was broken, which made the comparative study a bit more difficult than expected. Nevertheless, examination of the shells showed that *E. conwaiae* differs in several ways from *E. alaquaense*. *Epitonium conwaiae* is more slender than *E. alaquaense* and has 3.5 nuclear whorls versus 2.5 for *E. alaquaense* and the number axial ribs on the post-nuclear whorls on *E. conwaiae* range from 7–9 while the number of axial ribs on *E. alaquaense* ranges from 9–12. Current evidence suggests that that *E. alaquaense* is not found in the younger Shoal River Formation since none of the specimens examined were similar to Mansfield's shell.

The eroded form of *E. conwaiae* is also similar to the fossil species *Epitonium santodomingonum* Pilsbry, 1921, from the Pliocene beds of Santo Domingo (Dominican Republic) and *Epitonium antillarum* (de Boury, 1909) from Pliocene beds in Virginia and North Carolina (Gardner, 1948) and Florida (Olsson and Harbison, 1953). Like *E. conwaiae*, both fossil Pliocene species possess numerous spiral cords on the body whorls, lack a basal ridge, and both have low, well developed costae on the body whorls which increase in width near the aperture. *Epitonium conwaiae* differs from *E. santodomingonum* by having fewer costae on the last body whorl (9 versus 18) and an absence of varices on the last whorl of the shell. *Epitonium antillarum* differs from *E. conwaiae* by possessing fewer varices (7–9 versus 10–13), fewer teleoconch whorls (6 versus 8–9), thinner costae on the body whorls, a thinner lip surrounding the aperture, and a more acute spire angle (22° versus 30°). It should be noted that *E. antillarum* is no longer considered a valid species. In 1909, de Boury assigned the species *antillarum* to the epitoniid *Scalaria turricula* Sowerby, 1844. However, the shell Sowerby (1844) described had already been named by d'Orbigny (1842) as *Scalaria candeana*. Subsequently, Clench and Turner (1952) rectified de Boury's mistake by recognizing *E. antillarum* as *Epitonium candeanum*. Of further note, the shell described by Clench and Turner (1952) as *E. candeanum* does not fit the description of *E. antillarum* given by Gardner (1948) and later listed by Olsson and Harbison (1953) in their treatise on *Pliocene Mollusca of Southern Florida*. According to Clench and Turner (1952), *E. candeanum* has thinner and more numerous costae (18–25 versus 10–13) on the body whorls than does the species described by Gardner (1948) as *E. antillarum*. In all probability the *Epitonium* described by Gardner (1948) is a new species. It is beyond the scope of this paper to rectify this error and any effort to do so is being left to the work of future investigators.

Epitonium hoerleae new species
(Figures 69–73)

Deseription: Shell medium height, sturdy, turriculate; 3.5 smooth, glossy, protoconch whorls, 7.5 convex teleoconch whorls separated by deep suture. Spire angle 24°. Eight to nine thin costae on last body whorl. Costae slightly reflected backwards. At the whorl shoulder costae are slightly expanded and form a cusp-like node. Costae connected to one another at the suture, forming an oblique angle to the shell's central axis. Extremely faint spiral threads on glossy body whorls. No umbilicus. No basal cord. Aperture suboval. Outer lip of aperture thin and reflected backwards.

Holotype: USNM 534488, maximum height 8.8 mm, maximum width 3.2 mm.

Type locality: Tenmile Creek 03 (CA017) (= Tulane University locality TU 546), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

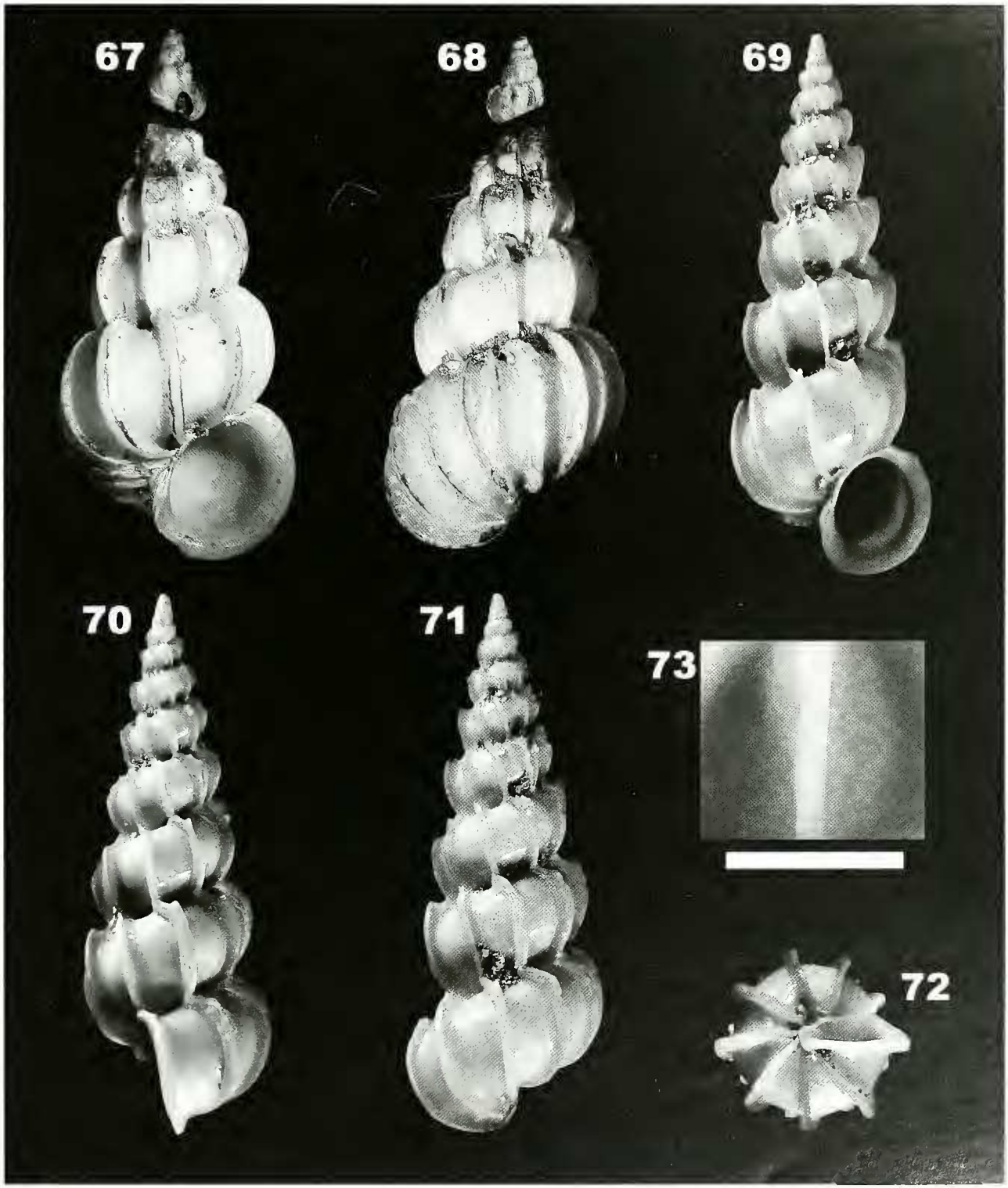
Paratypes: USNM 534498, 1 shell, locality and formation same as holotype; UF 84579, protoconch missing and aperture broken, Tenmile Creek 01 (CA002) (= Tulane University locality TU 830), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 101862, 1 shell, protoconch missing and aperture broken, Tenmile Creek 13 (CA058) (= Tulane University locality TU 1097), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 99083, 1 shell, Chipola 23 (CA037) (= Tulane University locality TU 711), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 94317, 2 shells, Chipola 13 (CA027) (= Tulane University locality TU 458), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Distribution: *Epitonium hoerleae* is a very common, widely distributed species. It has been found at the type locality of Tenmile Creek as well as along Farley Creek and the Chipola River.

Etymology: The species was named in honor of Shirley Hoerle, one of the pioneer researchers of Chipola Formation mollusks.

Discussion: Clench and Turner (1951) placed epitoniids that possessed glossy whorls and extremely faint spiral threads into the subgenus *Epitonium*. This classification has been retained with *E. hoerleae*.

Among recent species *E. hoerleae* is most similar to *Epitonium foliacecostum* d'Orbigny, 1842, which inhabits offshore waters in the Caribbean and along Florida's east coast. Both the fossil species and its Recent counterpart have glossy body whorls with faint spiral threads, approximately the same number of costae on the last body whorl (8–9 versus 7–8), and a slightly reflected



Figures 67–73. *Epitonium alaquaense* Mansfield, 1935, and *Epitonium hoerleae* new species. **67–68.** *Epitonium alaquaense*, apertural and abapertural views of holotype USNM 373149 shown for comparison to *E. conwaiae*. **69–72.** *Epitonium hoerleae*; apertural, lateral, abapertural, and basal views of holotype USNM 534488; maximum height 8.8 mm, maximum width 3.2 mm. **73.** Magnified view of sculpture of teleoconch of USNM 534488. Scale bar = 0.93 mm.

aperture lip. *Epitonium hoerleae* differs from the Recent shell by having a greater number of nuclear whorls (3.5 versus 1.5), less elevated costae and a more slender body configuration.

A comparison of *E. hoerleae* with a number of fossil species shows that it most closely resembles *Epitonium fargoi* Olsson and Harbison, 1953, which was described from the Plio-Pleistocene Caloosahatchee Formation of south Florida as well as *Epitonium proximus* (de Boury, 1890) which was described from the early Pliocene of France and the middle Pliocene of England (Harmer, 1920–1925). Both *E. hoerleae* and *E. fargoi* have convex, glossy, body whorls, approximately the same number of costae on the last body whorl (8 versus 9), the costae are reflected backwards, and both have a small cusp-like node on the upper shoulder. *Epitonium hoerleae* differs from *E. fargoi* in that it has a more expanded reflected outer lip, lacks a thickened cord on the inner lip, its costae are thinner and more blade-like and the spire angle in *E. hoerleae* is less acute (24° versus 20°) than its Pliocene counterpart. The European species, *E. proximus*, differs from *E. hoerleae* in that it is larger and more slender than its American counterpart and has more varices on the body whorl (11–13 versus 8–9).

Epitonium kallistos new species
(Figures 74–78)

Description: Shell small, turriculate; 3.5 smooth, glossy, protoconch whorls, 6.5 convex teleoconch whorls separated by a deep suture. Six moderately thickened, slightly recurved costae on last body whorl. Spire angle 25°. Costae connected to one another at suture forming an oblique angle with the central axis. Costae lack a cusp-like node on the shoulder of body whorl. Body whorls smooth and glossy. No umbilicus; basal cord absent. No varices. Aperture suboval, lip slightly thickened and recurved.

Holotype: UF 44614, maximum height 6.8 mm, maximum width 2.3 mm.

Type Locality: Tenmile Creek 02 (CA003) (= Tulane University locality TU 70), Altha West Quadrangle USGS 7.5′ Series (1982), Calhoun County, Florida, Chipola Formation.

Distribution: *Epitonium kallistos* is known only from the type locality.

Etymology: Name is derived from the Greek word *kallisto* meaning most beautiful.

Discussion: Among Recent and fossil epitoniids, *E. kallistos* is most similar to *Epitonium unifasciatum* (Sowerby, 1844), a species that today ranges from southern Florida to the Lesser Antilles (Clench and Turner, 1951). *Epitonium unifasciatum* has also been reported from the upper Miocene deposits of the Entrerriense Formation of Chubut Province, Argentina (Brunet, 1995). Like its Recent and fossil counterpart, *E. kallistos* has smooth, shiny, convex whorls, the aperture is suboval, there is no basal ridge, and the outer lip of the aperture is reflected backwards. *Epitonium kallistos* differs from *E. unifasciatum* by having fewer costae on the last body whorl (6 versus 7 – 9), a greater spire angle (25° versus 20°), more deeply impressed sutures, and the costae on the body whorls are more elevated.

Subgenus *Gyroscala* de Boury, 1887
Epitonium vokesae new species
(Figures 79–83)

Description: Shell small, turriculate; three smooth, glossy, bulbous protoconch whorls, 5.5 moderately convex teleoconch whorls. Suture moderately impressed. Spire angle 27°. Eight to nine slightly raised, blade-like costae on body whorl. Costae sinuous, not joined at suture with costae on preceding whorl. Distinct, narrow, basal ridge present. No varices. No umbilicus. Outer lip missing.

Holotype: UF 113898, maximum height 4.3 mm, maximum width 1.6 mm.

Type Locality: Tenmile Creek 04 (CA020) (= Tulane University locality TU 951), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

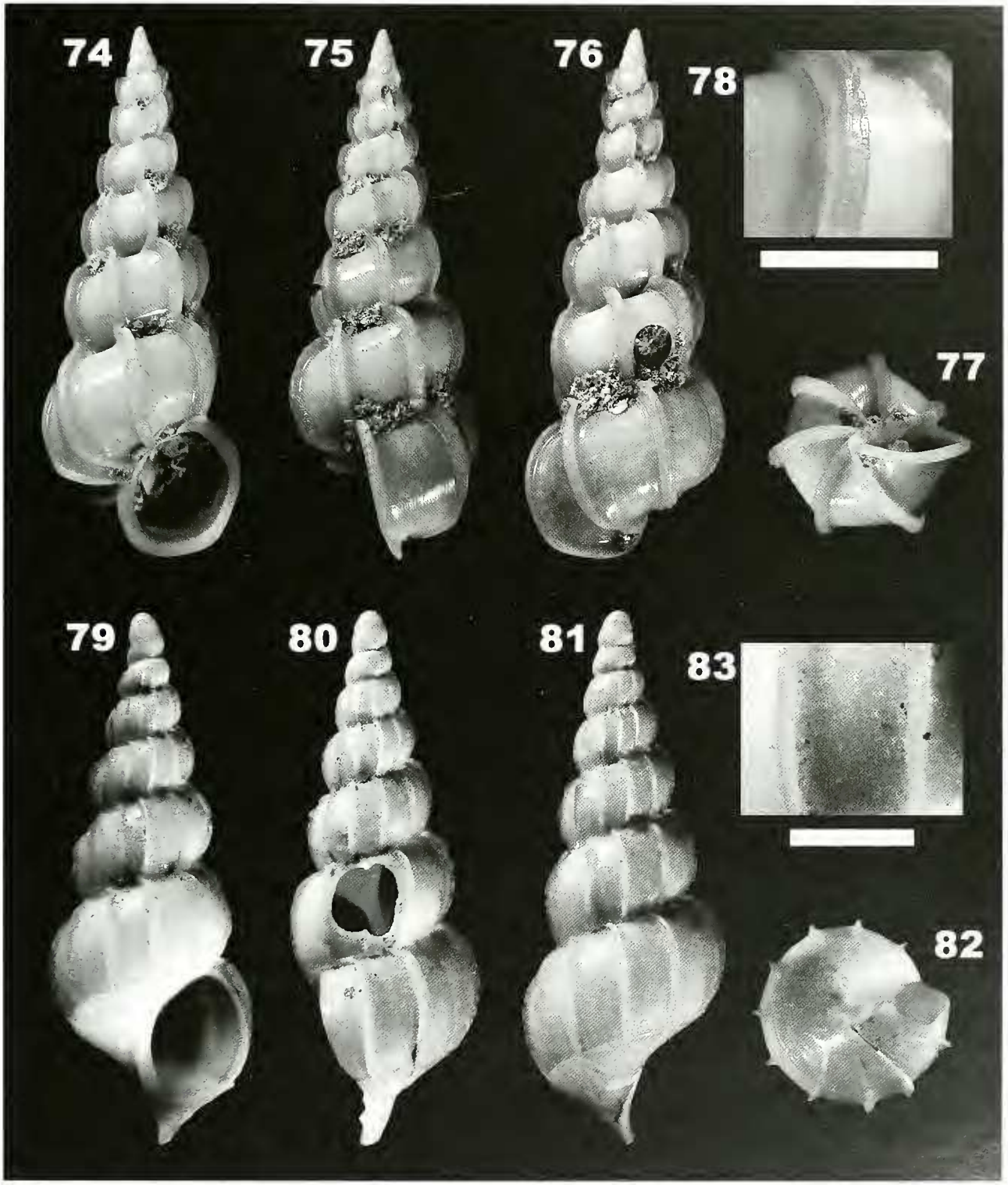
Paratypes: UF 114957, 1 shell, Tenmile Creek 03 (CA017) (= Tulane University locality TU 546), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation; UF 99136, 1 shell, spire missing, Chipola 23 (CA037) (= Tulane University locality TU 711), Clarksville Quadrangle USGS 7.5′ Series (1945), Calhoun County, Florida, Chipola Formation.

Distribution: *Epitonium vokesae* has only been collected along Tenmile Creek and the Chipola River.

Etymology: Named in honor of Dr. Emily Vokes, a leading researcher of the family Muricidae and a mentor to the many who have studied Chipola Formation fossils.

Discussion: *Epitonium* of the subgenus *Gyroscala* possess a smooth protoconch of about three whorls, high axial lamellae, gently convex smooth body whorls, a well defined, thin basal cord and a thickened peristome (Kilburn, 1985).

Thiele (1929) and a number of other European workers have made *Gyroscala* subordinate to *Cirsotrema*. Clench and Turner (1951) and Abbott (1974) retained de Boury's (1887) taxonomic classification of *Gyroscala* as a subgenus of *Epitonium*. Kilburn (1985) followed the lead of Australian and Japanese malacologists and accorded *Gyroscala* full generic status. According to Nakayama (2003), the presence of a basal cord in *Gyroscala* justifies raising this epitoniid to generic level. Once *Gyroscala* was raised to generic status, a number of investigators suggested establishing subgenera. Kilburn, for example, suggested two subgenera (*Boreoscala* and *Circuloscala*), while Nakayama suggested three (*Fragiliscala*, *Pomiscala*, and *Circuloscala*). As noted earlier, Nakayama al-



Figures 74–83. *Epitonium kallistos* new species and *Epitonium vokesae* new species. **74–77.** *Epitonium kallistos*; apertural, lateral, abapertural, and basal views of holotype UF 44614; maximum height 6.8 mm, maximum width 2.3 mm. **78.** Magnified view of sculpture of teleoconch of UF 44614. Scale bar = 0.81 mm. **79–82.** *Epitonium vokesae*; apertural, lateral, abapertural, and basal views of holotype UF 113898; maximum height 4.3 mm, maximum width 1.6 mm. **83.** Magnified view of sculpture of teleoconch of UF 113898. Scale bar = 0.37 mm.

ready used *Boreoscala* as a subgenus for *Cirsotrema*. To further complicate the issue Weil et al. (1999) elevated *Gyroscala* to the generic level but avoided using any subgenera. Until a more comprehensive study has been done with *Gyroscala*, we have decided to retain *Gyroscala* as a subgenus of *Epitonium* as suggested by de Boury and retained by Clench and Turner.

Representatives of the subgeneric group *Gyroscala* are not very common. There are three reported living species of the subgenus *Gyroscala* in the western Atlantic. *Epitonium lamellosum* Lamarck, 1822, is found from Lake Worth, Florida, to the Lesser Antilles, as well as from France to South Africa. Recently, Garcia (2002), reported *E. lamellosum* from the Indo-Pacific to California. *Epitonium rupicola* Kurtz, 1860, is found from Provincetown, Massachusetts, in the Atlantic to the Texas coast in the Gulf of Mexico, whereas *Epitonium xenicima* Melville and Standen, 1903, is a circum-global species (Garcia, 2006). None of the Recent western Atlantic species appear similar to the Chipola Formation species which is much more slender, lacks varices on the last whorl, has far fewer costae on the body whorls, and possesses a very distinctive, bulbous protoconch.

There are three fossil species similar to *E. vokesae*. One is *Epitonium aciculum* (H. C. Lea, 1843) which, according to Campbell (1993), was misidentified by Gardner (1948) as *E. pratti*. The species comes from the Pliocene Yorktown Formation in Virginia and North Carolina as well as the Plio-Pleistocene Waccamaw Formation in North Carolina. *Epitonium vokesae* is more slender than the Virginia and North Carolina species. In addition, it has far fewer costae on the body whorl (9 versus 16–25). The other two fossil species similar to *E. vokesae* are an unnamed specimen from the Miocene Chagres Formation of Panama (Woodring, 1959) and *Epitonium magnolianum* (Olsson, 1916) from the lower to middle Pliocene deposits from North and South Carolina and Georgia. Both the Chipola Formation and Panama fossil species lack spiral sculpturing, have low sinuous costae on the body whorls, and a suppressed basal disk. The Chipola Formation species differs from the Panama fossil in that it is much more slender and has far fewer costae on the body whorl (9 versus 21). *Epitonium vokesae* is also a much more slender species than *E. magnolianum* and lacks varices.

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